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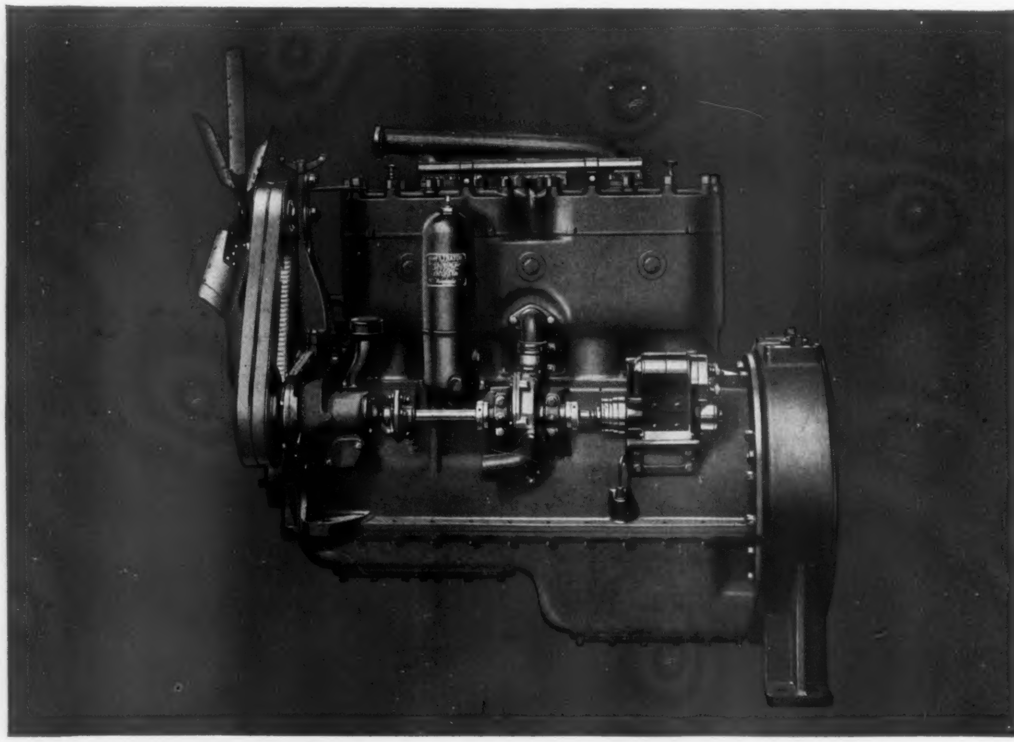

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Mount Airy Granite For Arlington Memorial Bridge

The North Carolina Granite Corporation Is Supplying Stone For the Superstructure of This Splendid Project

By R. G. SKERRETT

AT an outlay of substantially $15,000,000, the United States Government is rearing the Arlington Memorial Bridge which will link the Mall in Washington with the National Cemetery at Arlington, Va. This magnificent stone structure will form one more spectacular feature in the broad reservation which will thus virtually extend from the Capitol directly to the Virginia hills just west of the Potomac River.

The superstructure of the Arlington Memorial Bridge is being built of stone from the Mount Airy quarry of the North Carolina Granite Corporation. That quarry obtains its stone from an enormous formation of solid granite of a notable uniformity of texture and color. This article describes how the granite is first broken loose from the ledge and then cut up and shaped to meet varying requirements. In this work compressed air has an unusually important part to play.

MOUNT Airy granite has won for itself an enviable reputation in many parts of this country; but it is now destined to attain international note because of its use in the building of the Arlington Memorial Bridge across the Potomac River. But before we touch upon this beautiful and significant structure that is taking form, let us sketch the history of Mount Airy granite and what the North Carolina Granite Corporation has done to make that stone available.

Just when the crust of the earth heaved in that section of the continent no one knows with certainty, but when that movement occurred a vast shoulder of granite was shoved surfaceward. Subsequently, various erosive actions wore away the superposed rock and earth; and in the course of time a broad and nearly flat expanse of granite was bared to the light of day. This happened at a point in North Carolina about a mile east of where the town of Mount Airy came into being ages later and something like three miles south of the Virginia state line. So much for the genesis of what long was known as the Flat Rock.

Years before the North Carolina Granite Corporation was organized, and when near-by Mount Airy was scarcely more than an unpretentious village whose main street was nearly knee-deep in dust in the summertime and a still deeper quagmire in winter, the surrounding country was devoted to agriculture, if utilized at all, and many large tracts in the outlying neighborhood were bought or sold for a dollar an acre. This cheapness was largely due to their inaccessibility for months running—the roads being little better than mere trails, and passable from December to April only on the backs of horses or mules.

In those days, social intercourse was sorely hampered except during the warm months; and then acquaintances and friends foregathered numerously to participate in picnics held on or about the Flat Rock. The rock lay smooth and bare and warm in the sunshine—a bald expanse of something like twenty acres in extent, and was enveloped by acres and acres of primeval woodland. At the foot of the rock were two fine springs of pure, cold water, making the site admirably suited to the purposes of outdoor festivity. In that favorable atmosphere, the older people sat and talked of the things of interest to them; the children played about in perfect freedom; and the young folk found many needlessly declared missions to excuse their disappearance into the leafy dells—always in pairs.

While the glamor of romance clung to the Flat Rock for the reasons stated, the owner of the land looked upon that stony outcrop as a worthless encumbrance; and he became wrathful just once so often when called upon to pay taxes upon that barren granitic area. But the march of progress was to place that mass of stone in a different economic light.

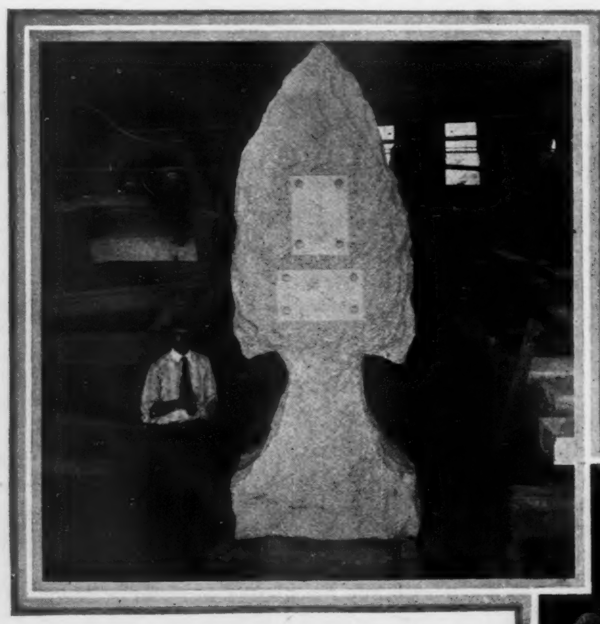
In June of 1888, Mount Airy was linked with the outside world by the Cape Fear & Yadkin Valley Railroad. One torrid day in that fateful month the citizenry of Mount Airy were roused from their seasonal lethargy by the tooting of a wood-burning locomotive drawing the first train into the town. The occasion was ample warrant for exuberation; but none of the eloquent citizens that prophesied what the railroad would do for the community heeded that broad patch of granite near by which was to give a new meaning to the railway and its potential value to Mount Airy. Such is the way we so often miss the silent significance of many things about us in the glamor surrounding some noisy self-advertising creation of the moment. But Thomas Woodroffe was of a different stripe; he was a man of practical vision.

Woodroffe, a carpenter and contractor of Greensboro, had built a number of the modest stations placed along the line of the new rail-

road, and somehow he became interested in the Flat Rock as a source of structural granite. His enthusiasm was such that he was able to obtain the monetary support of other men in Greensboro and the vicinity; and on May 8, 1889, the owner of the rock deeded a 40-acre tract—of which the exposed granite was a part—to J. A. Odell, also of Greensboro. Additional adjacent land was acquired, and the mineral rights obtained to approximately 175 acres to the south of that outcrop. Six days later the Mount Airy Granite Company was incorporated with a capitalization of $25,000. A great industry was thus set upon inexperienced feet that were later called upon to follow a rough road beset with many obstacles before Nature's amazing store of excellent granite could be quarried, cut, and marketed profitably.

The purpose of this article is not to recount the business vicissitudes of the Mount Airy Granite Company, but to emphasize achievement. In May of 1904 the North Carolina Granite Corporation obtained a franchise; and shortly thereafter the new concern took over the holdings of the Mount Airy Granite Company for a consideration—spending a considerable sum on new buildings and additional equipment. The North Carolina Granite Corporation made earnest efforts, but business reverses—customers failing for large sums at crucial periods—nullified those efforts. Again, a man of practical vision grasped the possibilities of Mount Airy granite and blazed the way to business success in the utilization of that vast and unique deposit. We refer to J. D. Sargent.

Mr. Sargent was of New England birth and had served his apprenticeship in the famous Barre granite district of Vermont. Arriving at Mount Airy in 1910, he promptly became identified with activities at the quarry; and in 1916 he obtained the lease of the existing cutting sheds at a nominal figure. Previously the sheds had not paid; and the corporation was quite willing to quarry the granite and to sell rough blocks of it to Mr. Sargent as long as he was able to buy them. He made a success of the business instead of failing, as many believed he would; and with that example of heartening accomplishment the North Carolina Granite Corporation wisely induced him to take over the management of the quarry, itself. This was in 1918—two years after the J. D. Sargent Granite Company had been organized to operate the cutting sheds. Before 1918 came to a close, the J. D. Sargent Granite Company was merged with the North Carolina Granite Corporation. From that time onward the story of the corporation is a record of steady progress that had its climax in July of 1926 when the corporation was able to cancel the last of the bonds of the old fixed debt. In his splendid work to this end Mr. Sargent has gathered about him able associates and assistants. The corporation was, thanks to the changes wrought under Mr. Sargent's guidance, fully qualified in every way to enter into a contract to produce more than $1,500,000 worth of stone for the Arlington Memorial Bridge. The quarrying and the cutting of this granite is the biggest single undertaking which the corporation now has in hand.

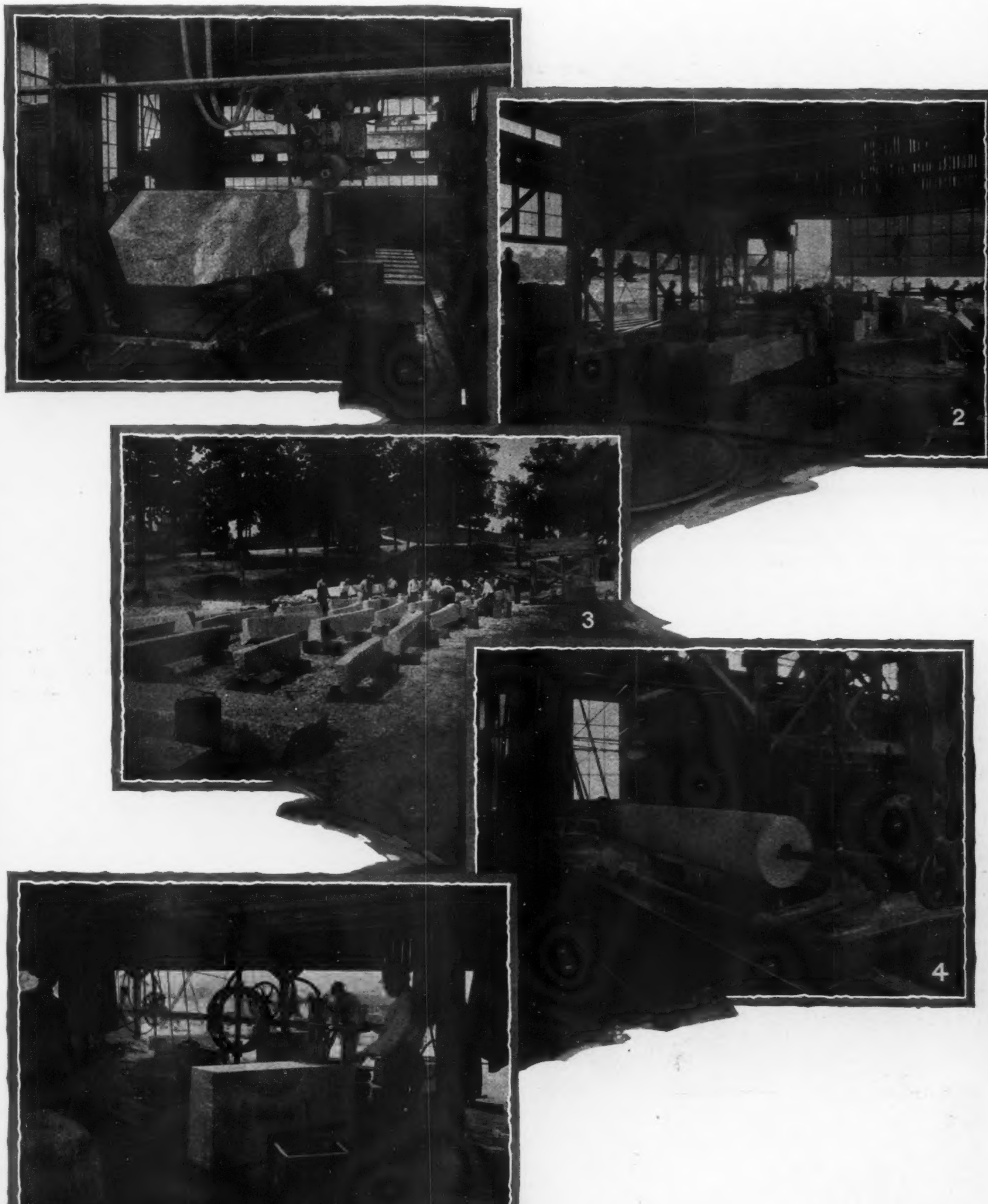


Left—One of the numerous arrowhead markers that are to be placed along the Daniel Boone Trail where it crosses North Carolina.

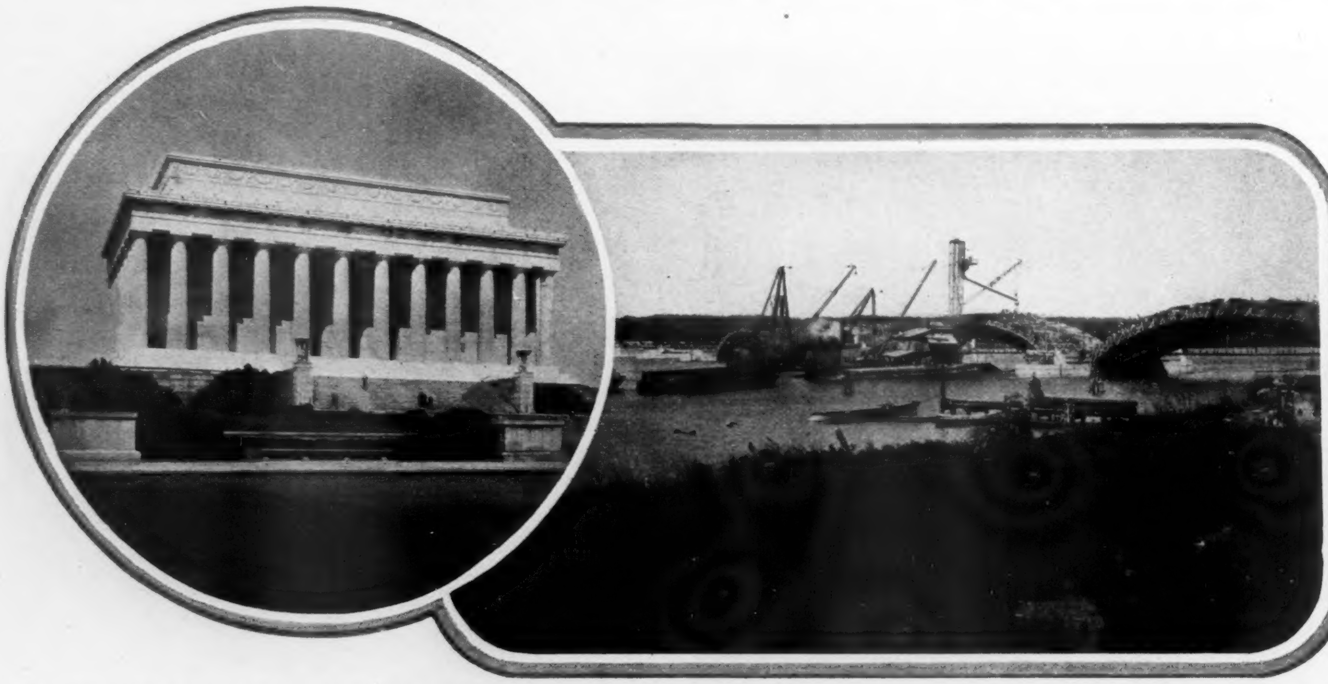
Right—Pointing device used in transferring dimensions from a model to the stone that is being cut.

Bottom—One of the sixteen carved Buffalo heads that will adorn the Arlington Memorial Bridge.

The Mount Airy quarry produces a biotite granite of medium texture and of an extremely pleasing very light-gray color. The feldspar is nearly white, the quartz is a blue gray, and the mica is black. Because of the even manner in which these components are distributed throughout the mass, the stone is of a uniform color that makes it suitable for a wide range of uses. Besides this uniformity of color and quality it is possible to obtain any desired quantity of granite. This is of importance in carrying out extensive structure undertakings or in extending structures originally built of the material.



1—Carborundum wheel cutting a block of granite in one of the mills of the North Carolina Granite Corporation. 2—Some of the many air-operated surfacing machines of the North Carolina Granite Corporation. 3—Making curb stones in an open-air cutting yard on the property of the North Carolina Granite Corporation. 4—Turning a granite column in a lathe. 5—Close-up of a pneumatic surfacer at work on a block of granite.



Left—Lincoln Memorial behind which is the east approach to the Arlington Memorial Bridge. Right—Making progress on the Arlington Memorial Bridge, showing forms for the spans in position.

A report by the state geologist of North Carolina gives the following analysis of Mount Airy granite:

SiO_2	70.70
Al_2O_3	16.50
Fe_2O_3	2.34
MgO	0.29
CaO	2.96
Na_2O	4.56
K_2O	2.45
FeS_2	0.09
	99.89

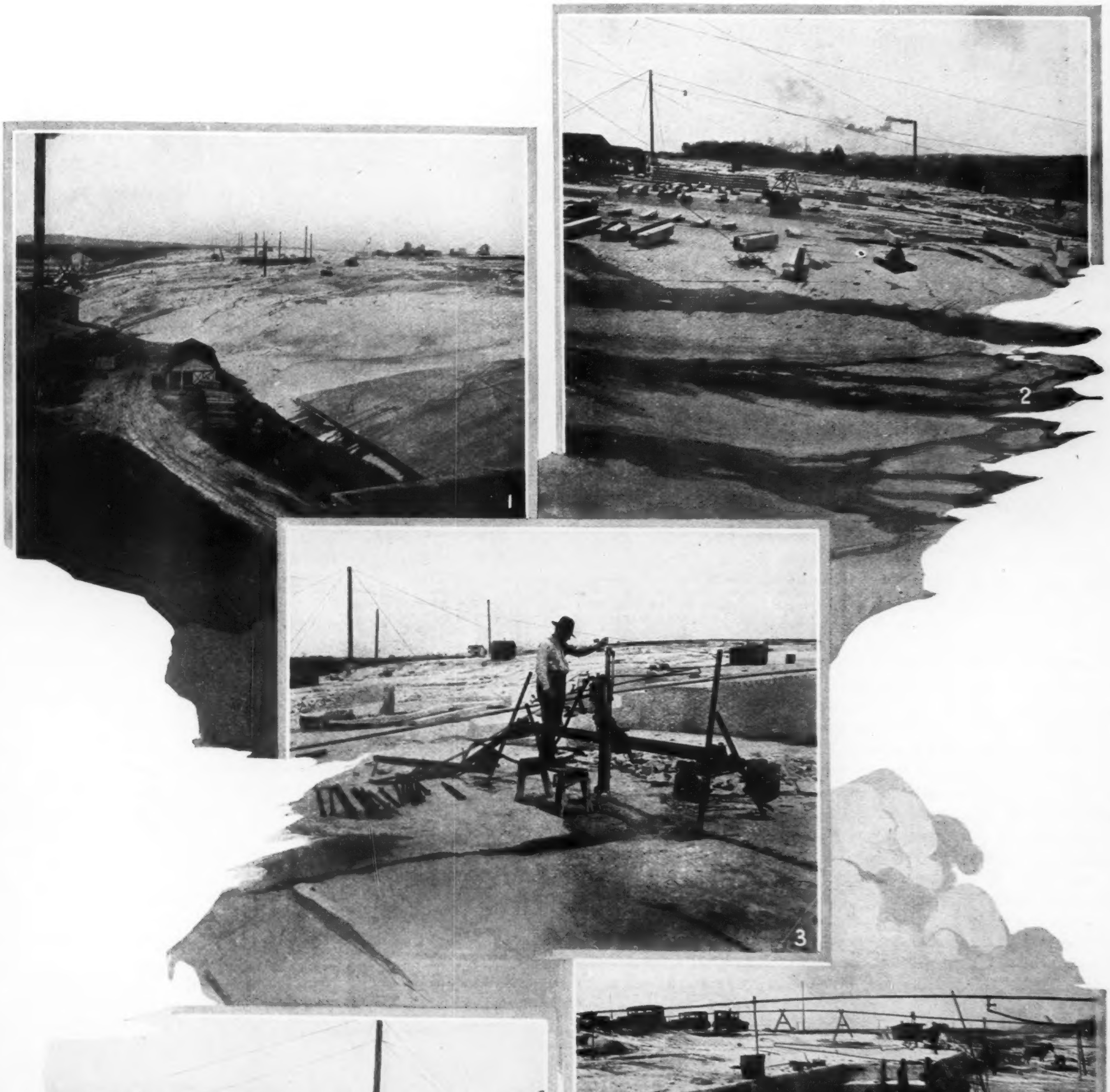
Tests made in the laboratories of the United States Arsenal at Watertown, Mass., disclosed these physical characteristics:

Weight, per cu. ft.	165 lbs.
Water absorbed, per cu. ft.	0.33 "
Crushing strength, per sq. in.	23,068 "

At the present time, the exposed surface of the quarry has an area of 75 acres; and from east to west the opening is 2,750 feet long. Its greatest north and south width is 1,800 feet. Unlike the granite in many other quarries, the deposit at Mount Airy is a single homogeneous mass without what is commonly termed sheeting planes. The surface of this hill of granite slopes about 12°, and there is approximately a difference of 100 feet between the crest of the quarry and the level of a railroad spur that runs parallel with its base. This difference in gradient is utilized to transport the quarried granite by gravity to the loading tracks. Cableways capable of carrying single loads of 7 tons are used in this service. There are many of these cableways; and the longest of them has a span of 1,300 feet.

No part of the work done at Mount Airy is more interesting than the unusual procedure followed in producing artificial sheeting planes in the great solid mass of granite. Fortunately, the nature of the rock is such that it can

How blocks of granite are split to prescribed dimensions by driving plugs and feathers in lines of holes drilled with plug drills.



1—View of the quarry as seen from the southwestern side of the property. 2—Looking southward on quarry floor from point near some of the numerous cutting sheds. 3—An X-70 drill, on a quarry bar, drilling and broaching the great mass of granite that has been lifted by the combined action of powder and compressed air. 4—Two large blocks of granite left in position for special use. The distance between the top and the bottom line indicates the thickness of the sheet of granite lifted from the solid ledge by powder and compressed air. 5—Section of the quarry floor where the lifted sheet of granite is being cut up into marketable blocks.

Top, left—Where the railroad runs along the lower side of the great quarry. Right—A gasoline-driven tractor is used frequently to haul blocks of granite to points where they can be picked up by the aerial cableways. Bottom, left—Even the blacksmith shops are built of granite. Right—One of the numerous air receivers about the property that also serve to remove moisture from the air lines.

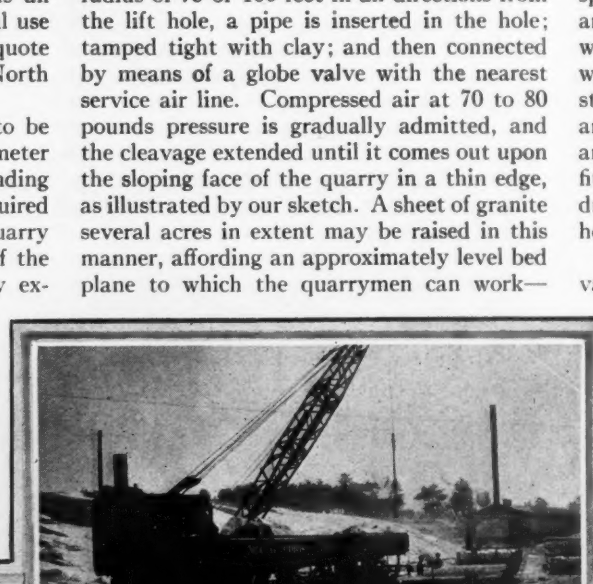
be split readily in any direction when force for that purpose is properly applied. Advantage is taken of this characteristic; and a method has been developed that makes it practicable to loosen large sheets or laminations from the mass much as one peels an onion. This is accomplished by a skillful use of explosives and compressed air. We quote from a description furnished by the North Carolina Granite Corporation:

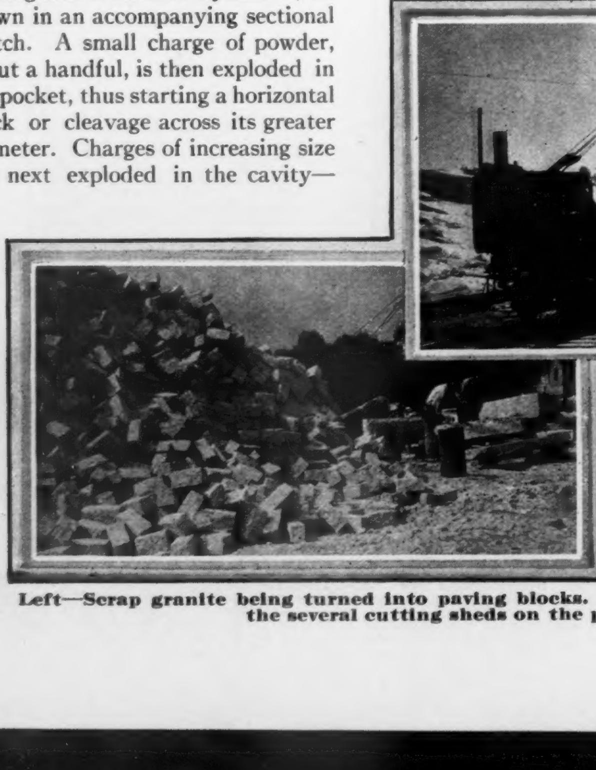
"In the center of the sheet or area to be 'lifted', a drill hole 3 or 4 inches in diameter is sunk from 5 to 8 feet in depth, depending on the greatest thickness of stone required and the contour of the surface of the quarry at that particular point. The bottom of the hole is then enlarged into a pocket by exploding half a stick of dynamite, as shown in an accompanying sectional sketch. A small charge of powder, about a handful, is then exploded in the pocket, thus starting a horizontal crack or cleavage across its greater diameter. Charges of increasing size are next exploded in the cavity—the drill hole being plugged at each blast to confine the powder gases and thus to exert a more or less constant lateral force upon the stone.

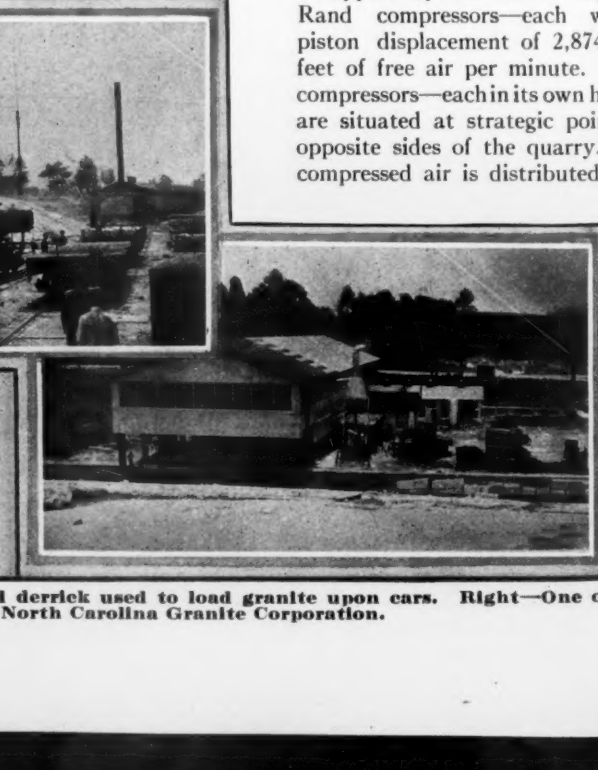
"After the cleavage has extended to a radius of 75 or 100 feet in all directions from the lift hole, a pipe is inserted in the hole; tamped tight with clay; and then connected by means of a globe valve with the nearest service air line. Compressed air at 70 to 80 pounds pressure is gradually admitted, and the cleavage extended until it comes out upon the sloping face of the quarry in a thin edge, as illustrated by our sketch. A sheet of granite several acres in extent may be raised in this manner, affording an approximately level bed plane to which the quarrymen can work—thus securing stone of any required thickness."

The general practice is to quarry inward from the outer edges of the sheeting or bed plane, forming a working face or faces by drilling lines of vertical holes and afterwards splitting the rock along those lines with plugs and feathers. The holes at this stage of the work are short or shallow ones, and are made with DCR-23 "Jackhamers" using 1-inch steels. The deep holes required in bench work and broaching are sunk with X-70, X-71, and X-72 Ingersoll-Rand rock drills that are fitted with broaching steels after they have drilled the needed lines of closely spaced holes.

Air for operating the rock drills and for various other uses in the cutting sheds, etc., is supplied by two PRE-2 Ingersoll-Rand compressors—each with a piston displacement of 2,874 cubic feet of free air per minute. These compressors—each in its own house—are situated at strategic points on opposite sides of the quarry. The compressed air is distributed to the







Left—Scrap granite being turned into paving blocks. Top—Railroad derrick used to load granite upon cars. Right—One of the several cutting sheds on the property of the North Carolina Granite Corporation.


Left—Drilling vertical holes in quarry floor with a BCR-23 "Jackhamer". Right—Block-holing a piece of granite with a BCR-23 "Jackhamer".

working areas by extensive mains; and capacious receivers are interposed at suitable positions to remove moisture and to insure a steady flow of air. A large volume of air is necessary because of the numerous rock drills, carving and cutting tools, and pneumatic surfacers. All told, there are 35 of the latter labor-saving machines in service. Compressed air also is utilized by sand-blasting nozzles that are employed in rough-forming some of the cut stone and in lettering.

The method of quarrying adopted at Mount Airy makes it practicable to get out economically blocks of granite of any desired size. Extra large and heavy pieces are moved down to the railroad at the lower side of the quarry on a track that runs across the quarry, whence they can be shifted to the big cutting sheds or transported elsewhere by rail. The maximum size of a block is limited only by the capacity of the freight car. Small blocks of granite are frequently hauled from the quarry face to the cableways by gasoline tractors that run freely over the relatively smooth and expansive floor of the quarry.

Perhaps a few figures will serve to indicate the growth of the operations at Mount Airy. During the first year of production—that is, in 1890, a total of 135 carloads of granite were shipped from the quarry. In 1904, the year the North Carolina Granite Corporation was organized, the output reached 1,282 carloads. Year by year, this production has increased; and during 1927 as many as 3,000 carloads were sent away by the North Carolina Granite Corporation. Each of those cars carried an average of 40 tons of stone. To accomplish this, a force of from 500 to 600 men is employed.

As might be expected, there is a large volume of scrap from this output of dimension stone; and such of it as is not worked up into curbing or paving blocks is run through a crushing plant, which has a daily capacity of 500 tons. This crushed stone is admirably suited to roadbuilding, concrete work, and the ballasting of railways.

A visit to Mount Airy discloses that considerable money has been spent in clearing up and in reconstructing the quarry for more efficient and more economical operation. Furthermore, the cutting sheds have been extensively reëquipped with typically up-to-date apparatus. This policy has been in force for some time; and explains in part why the North Carolina Granite Corporation is an outstanding example of fine and profitable management. The organization at Mount Airy is a complete one in all respects; and every department is supervised by a skilled


Left—One of the two Ingersoll-Rand PRE-2 compressors on the property of the North Carolina Granite Corporation. Right—One of the two Cameron No. 2 LV pumps that handle the water delivered to the compressor intercoolers.

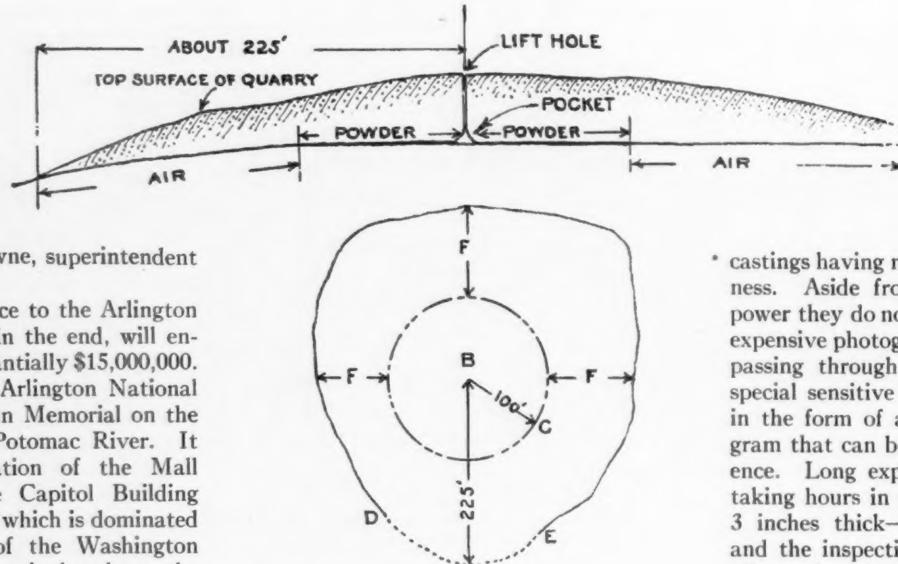
man that has grown up with the business. The officers of the corporation are: J. D. Sargent, president; W. F. Shaffner, vice-president; W. S. Martin, secretary and treasurer; C. Binder, general manager; F. Walker, quarry superintendent; and R. C. Browne, superintendent of cutting sheds.

Now for a brief reference to the Arlington Memorial Bridge which, in the end, will entail a total outlay of substantially $15,000,000. The bridge will link the Arlington National Cemetery with the Lincoln Memorial on the Washington side of the Potomac River. It really forms a continuation of the Mall which extends from the Capitol Building westward to the river and which is dominated by the towering shaft of the Washington Monument. Between terminal pylons, the bridge will be 2,138 feet long and will have a total width of 90 feet. It will be supported by nine segmental arches, and the center span will be 184 feet in length. The superstructure, rising above the supporting piers that have their bases in the river bed, will be constructed of Mount Airy granite; and acres and acres of that cut stone are now assembled on the Virginia side of the river to facilitate the prosecution of this magnificent undertaking.

A memorial bridge across the Potomac at Washington was first suggested by President Andrew Jackson about fourscore years ago; but the first appropriation for the present work was not made until 1913, and authority to go ahead with the project was not given until February 24, 1925.

In the report of the Arlington Memorial Bridge Commission appears the appended explanation of the work in hand: "This project has many important features which, taken together, will make it the greatest single memorial project undertaken by any nation in recent times. Following immediately after the Lincoln Memorial in time of construction, it fortunately supplements and completes that great Memorial in finishing the landscape in its vicinity, and carries the Mall treatment of Washington and l'Enfant across the Potomac to Arlington and up to the last resting place of the designer of the original plan of the Capital at the portico of the Lee Mansion.

"In addition to this relationship, there is the compelling patriotic motive in the project of a direct broad boulevard from the Capitol through B Street, extended and widened, by way of the Lincoln Memorial and on across the broad and dignified bridge as a route for the Nation's fallen heroes to their last resting place in the Arlington National Cemetery. There is a third great motive in the complete plan, and that is the provision of a magnificent entrance to Washington from Virginia for the Lee Highway coming across the entire country from Los Angeles, Calif. The fourth, and perhaps the greatest of all, is the symbol of the binding together



Upper sketch shows rock lifted by powder and supplemental area lifted by compressed air. In lower sketch, AB indicates radius of combined area lifted with the aid of powder and compressed air. B is the lift or drill hole; BC is radius of area lifted by powder; AFFF area cleaved by compressed air; and DE is the thin edge of the cleaved granite on the downhill side of the quarry. Here is where the compressed air escapes.

of the North and the South in one indivisible Union, knowing no sectional lines."

In the future, with the completion of the bridge and its approaches, the traveler on reaching the brow of Arlington Heights, Va., will have spread before him a panorama that will have few equals in the world. That scene will live vividly in his memory thereafter and serve as a perpetual inspiration to loyalty and devotion to the country.

The building of the Arlington Memorial Bridge is under the general supervision of Lieut. Col. U. S. Grant 3rd, of the Corps of Engineers, United States Army.

RADIUM RAYS DETECT FLAWS IN METALS

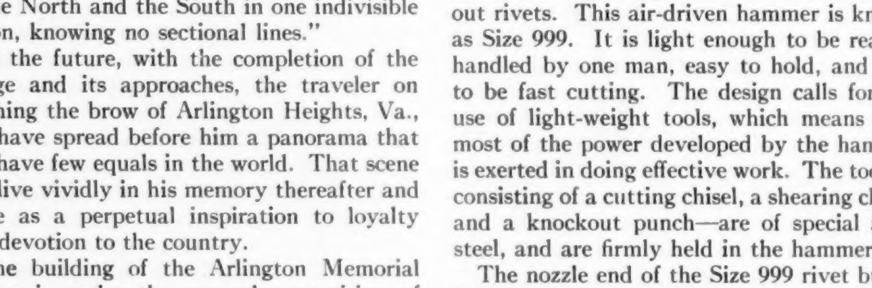
MOST of us are familiar with the use of the X-ray in industry in revealing hidden flaws in metal and other materials. Hitherto it has had no competitor in this field; but now we are authoritatively informed by the Russian State Radium Institute, at Leningrad, that radium rays are superior to X-rays for this purpose because they are more penetrating and will pass through pieces of metal, for example, that are too thick to be examined with X-rays.

The gamma rays emanating from radium are of much shorter wave length than X-rays; and at the institute in question they have been used with success on large castings having metal walls 15 inches in thickness. Aside from their greater penetrating power they do not require the employment of expensive photographic plates—the rays, after passing through the object, acting upon a special sensitive electroscope. The record is in the form of an automatically traced diagram that can be filed easily for future reference. Long exposures of plates—sometimes taking hours in the case of metal more than 3 inches thick—are thus done away with, and the inspection of large castings may be effected in a couple of minutes.

PNEUMATIC RIVET BUSTER OF IMPROVED TYPE

A NEW rivet buster has been produced by the Ingersoll-Rand Company, of New York City, for cutting or busting off rivet heads up to ¾ inches and for knocking out rivets. This air-driven hammer is known as Size 999. It is light enough to be readily handled by one man, easy to hold, and said to be fast cutting. The design calls for the use of light-weight tools, which means that most of the power developed by the hammer is exerted in doing effective work. The tools—consisting of a cutting chisel, a shearing chisel, and a knockout punch—are of special alloy steel, and are firmly held in the hammer.

The nozzle end of the Size 999 rivet buster is finished with a heavy square-section thread, over which is screwed a retainer nut. This nut acts as a shock absorber for the hammer when the associate tool is not held against the work. The effectiveness of this retainer feature is attributed to a heavy, strong knob on the upper end of the taper-shank tools employed. This knob provides a shoulder through which the blows are successively transmitted to a split nozzle, a rubber buffer, and thence on to the retainer nut—thus effectually absorbing the concussion. This knob makes it possible to utilize light-weight tools because it does not weaken the shank as notches or grooves are apt to do; and it prevents the tools from being shot out of the hammer.

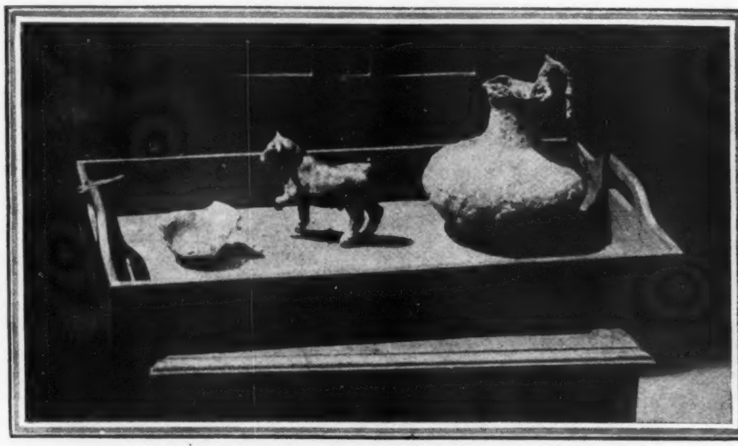


The new Size 999 rivet buster, showing one of the special chisels and the retainer feature.

Uncovering Long-Buried Herculaneum

By F. VIGO

HERCULANEUM perished with Pompeii when Mount Vesuvius poured forth its devastating torrents in the summer of the year 79 A. D. At the time of that awful catastrophe, Herculaneum was a favorably located seaside resort that had drawn to it many well-to-do rich Roman citizens. We of the present age should be interested in what Strabone wrote about Herculaneum in the first century of the Christian era, because we see, again, how history has a way of repeating itself.



Some of the artifacts unearthed during the early stages of the excavating now in hand.

According to that authority: "This quiet and pretty little town has been completely Romanized and owes its prosperity to the fact that the rich Romans have chosen it as a resort where they can find refuge when tired from the smoke, dust, and noise of Rome."

Before the day of its overwhelming, Herculaneum was set between two streams, at the foot of Vesuvius, and upon a hill overlooking the sea—undoubtedly, a picturesque and an attractive position. Then came the disaster that covered the town and its beautiful villas deep beneath an irresistible flood of mud that swept over it from the belching bowels of Vesuvius. For centuries Herculaneum lay undisturbed, undiscovered under that volcanic blanket. Many of the artistic features of Pompeii were destroyed by the consuming heat of the ashes that smothered her; but the nature of the inundating material that rolled down upon Herculaneum happily did but little damage to the things of beauty assembled there. This has been evidenced during the intermittent explorations of the past, and is becoming still more apparent through the splendid work now being done in uncovering Herculaneum with the aid of modern excavating equipment.

The mixture of mud, ashes, fragments of lava, pumice stone, and tufa that covered the whole of Herculaneum has been found to have an average depth or thickness of 50 feet; and, in the course of time, the mass has been transformed into a conglomerate of considerable consistency. The first serious attempt to reach buried Herculaneum was made in 1738, and this was followed by work undertaken in 1828 and 1869. Much of the excavating was done in a haphazard fashion and in a way calculated to increase the hazards of those that might follow afterwards. Statues, bronzes, and papyri so recovered have revealed the artistic eminence of Herculaneum and have whetted the intellectual appetites of scientists and archeologists. The work now in hand bids fair to accomplish what has heretofore been impossible of attainment.

The object now is not simply to bring to light a few remains, some deserted and silent ruins, but, instead, to resurrect the entire city after a tragic sleep of substantially 2,000 years, and thus to recall a vanished world and to reconstruct the life and customs of a people through its houses, its streets, and its gardens. The task will, of necessity, prove a toilsome and difficult one because of the tremendous amounts of material that must be cleared away and because of the nature of that material.

The Italian Government, under the leadership of Mussolini, has taken up the work anew with fervor and energy, and has wisely adopted the aid of modern mechanical tools as the only means by which to carry on the explorations economically and systematically. After suitable preliminary tests, pneumatic tools were decided upon for breaking up and excavating the enveloping solidified volcanic material.

At first, it was feared that the use of machinery might cause damage to frescoes, statues, and other objects of art that might be encountered. Results, however, have shown that such apprehension is groundless; and air-driven clay diggers have turned out to be peculiarly fitted for the work in hand—doing it both rapidly and surely and being at all times susceptible of very nice control. These tools have performed splendidly even when their operators had to manipu-

Left—Portable air compressors and pneumatic clay diggers are rapidly uncovering archeological treasures at Herculaneum. Right—These air-driven diggers make short work of removing the now solidified rocklike formation that buried Herculaneum nearly 2,000 years ago.

late them in difficult and awkward positions. In short, one man with a pneumatic digger will do as much work as seven or eight men equipped with ordinary hand picks. Air for these tools is furnished by portable compressors; and for excavating in the harder conglomerate pneumatic paving breakers have been found very effective.

Our illustrations show only a few of the many archeological finds that have recently been brought to the light of day. Beautiful colonnades and portals have been uncovered that give ample evidence of the artistic skill of the architects and of the craftsmanship of the stoneworkers of that distant period. In fact, a large part of the things revealed by the modern excavator indicates both the refinement of the people and the luxury and elegance of their habitations and public buildings.

His Majesty the King of Italy making a personal tour of the scene of the newly started excavations at Herculaneum.

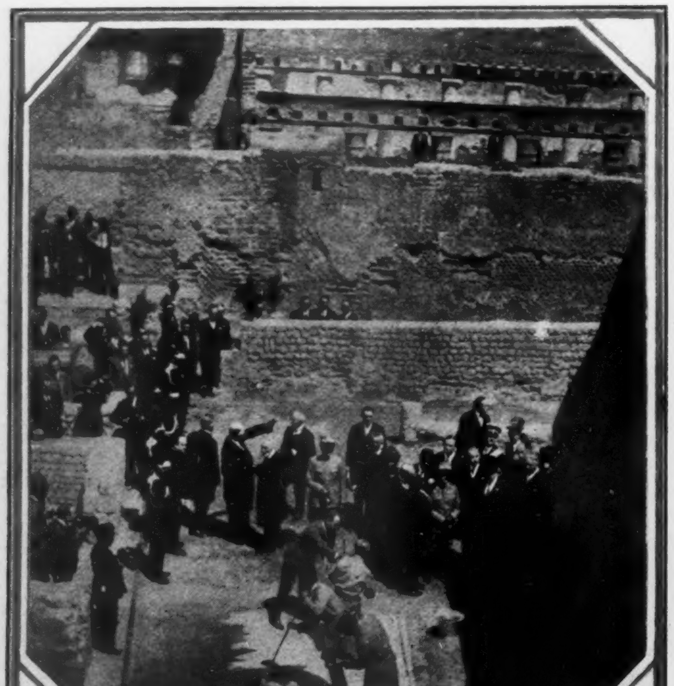
Interesting and encouraging as the discoveries so far made have been, still there is ample reason for the belief that further exploration will expose features of the long-buried city and the habits of life of its erstwhile population that will turn out to be of the utmost archeological significance. Undoubtedly, future success in the outcome of the work in hand will depend upon the continued use of the modern excavating machinery now at the disposal of the people engaged in this extremely absorbing undertaking. The whole world awaits with impatience what may be disclosed henceforth. Compressed air is thus rendering an immense service to both art and history.

EFFECT OF WATER ON PORTLAND CEMENT

RECENT investigations, made by an important French cement company, have shown that the action of ordinary surface water upon Portland cement piping differs greatly from that of pure distilled water. It was determined that distilled water causes the cement to dissolve and, ultimately, to disintegrate. No such harmful effect was noticed in the case of surface water. The explanation offered by the investigators is as follows:

Portland cement in setting frees a certain amount of hydrate of lime. This in contact with carbonic-acid gas or with bicarbonate is transformed into a neutral carbonate of lime which is insoluble. However, hydrate of lime is soluble in pure distilled water and, in consequence, brings about the gradual disintegration of the mortar. But with surface water, the precipitation of the neutral insoluble carbonate fills the pores of the cement, thus making it watertight and protecting it.

The use of the flotation process in the treatment of Michigan native copper ores is now an accomplished fact, thanks to research work, during the past year, of the United States Bureau of Mines. The solution of this problem, which has heretofore baffled investigators, makes it possible to increase the recovery of copper per ton of ore from 3 to 6 pounds. This means an added yield from that source of from 5,000 to 5,500 tons of copper annually.



Left—Uncovering a fine example of mosaic pavement. Right—Where air-driven clay diggers have exposed a beautiful pavement in the erstwhile villa of a wealthy Roman.

Experimental Mines Prove Practical Aids In Colleges and Industries

By C. H. VIVIAN

TECHNICAL schools have sometimes been criticized on the ground that their graduates know too little about the practical applications of the theoretical knowledge they possess.

Realizing that this is in a measure true, colleges and universities are making every effort to include sufficient laboratory and shop training in their courses to give students a fair working knowledge of the industrial methods and practices that they will meet when they leave the campus. At the same time, it is not the purpose of these institutions to turn out "practical" workers. Schools must remain primarily seats of theoretical learning rather than become industrial laboratories. Even if they wished to do so, they could not reproduce the highly varied conditions and have available the costly equipment found in the industrial fields to which their classroom instruction pertains. With the limited physical resources at their disposal, and in the comparatively brief time the student is under their guidance, the best the colleges can do is to give him glimpses of the practical procedure which he will become concerned with later on.

Carrying out the desire to acquaint undergraduates with working conditions and equipment, several American schools that offer mining courses now maintain facilities for actual underground operations by the students. These mines are of several types, and the manner in which they are used varies somewhat; but in all cases they serve to round out the theoretical instruction with practical training and experimental data obtained under operating conditions.

The Missouri School of Mines and Metallurgy at Rolla, Mo., maintains a mining laboratory on the site of an old dolomite quarry a short distance from the campus. A 9-acre tract of land was purchased for the purpose; and in 1913 work was started on the driving of an adit into the side of a hill of such topography that the workings will eventually have about 30 feet of cover. In 1921, in order to utilize the rock taken out and to make the mine more complete, a shaft was sunk to meet the adit at a point about 80 feet in from the portal. A Joplin type of headframe was erected and an English Iron Works 10x12-inch geared hoist was installed for raising the dolomite to the surface, where it is dumped into a small bin. The rock runs by gravity from the bin to a Blake crusher. The crushed stone is elevated to a storage bin, of 100 tons capacity, from which it is loaded as desired into trucks for hauling into the city.

Concerning the training which the students receive in the mine, Prof. C. R. Forbes, head of the department of mining, says: "The experimental mine was opened for the purpose of supplementing the classroom study of mining operations with a laboratory where practical demonstrations might be given. It was not started with the idea of giving a 'practical' course in mining, and it has never been used for that purpose.

"The total time spent by a student in this mining laboratory is 40 hours out of his 4-year course. He does his work there during the first half of his junior year, and the time spent in the mine represents less than 1 per cent of his total course. It is evident from these facts that the aim is not to make drill runners or practical miners. Most of the time is spent in drilling and blasting, but, as occasion demands, the students may be called upon to do tracklaying, timbering, or mucking. Drilling is done with dry and wet 'Jackhamers'; with large, mounted hammer drills; and occasionally with stopers. The work is so arranged that only two men are employed on a drill at a time, and whenever it is possible they are given a working place to themselves where they may drill and blast a complete round. The work consists for the larger part of drifting in headings from 6 to 10 feet wide and 7 feet high. Different types of rounds are put in and various kinds of explosives are used, the results being recorded and compared.

Group of Colorado School of Mines' students about to go underground for training in mine surveying.

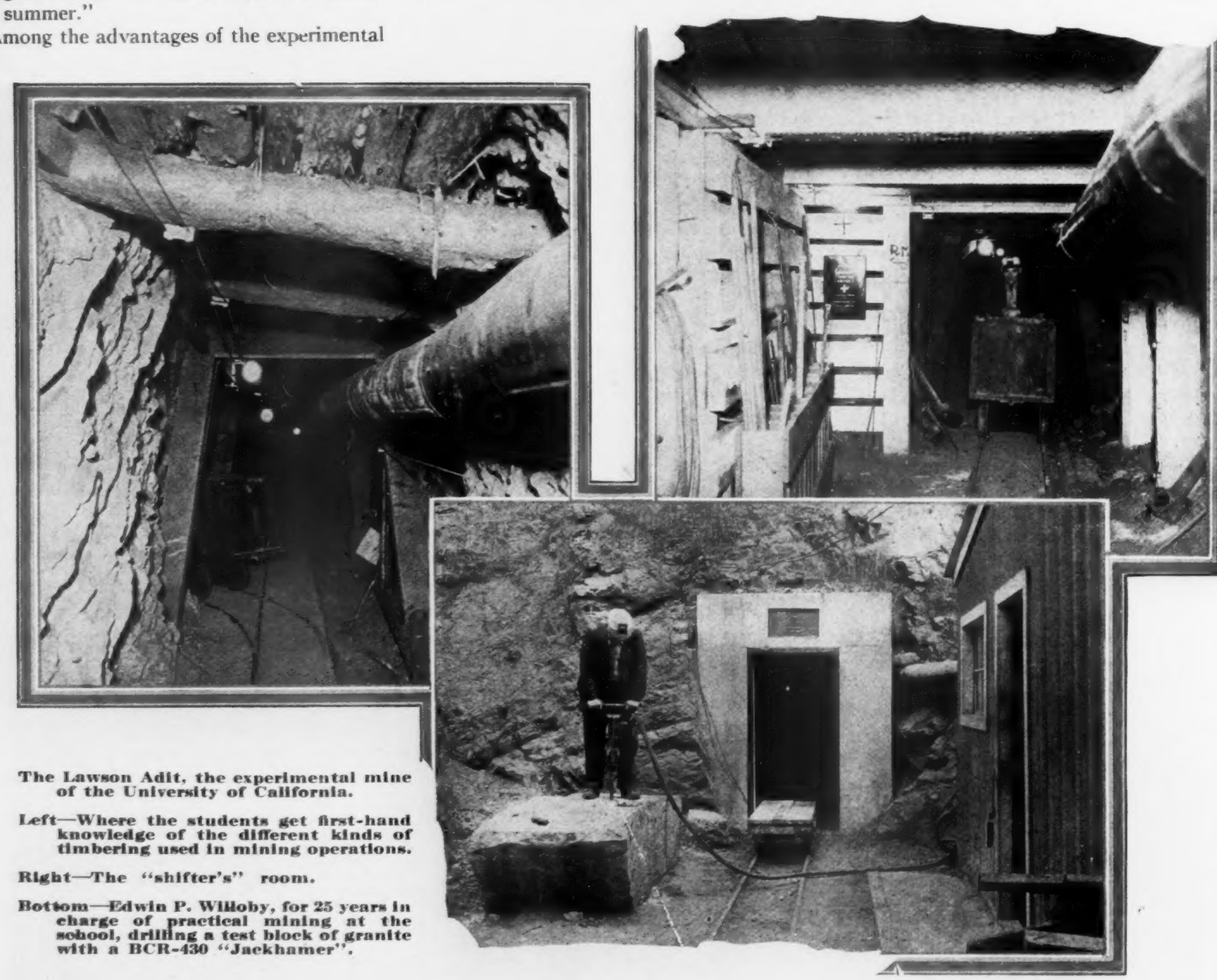
"The actual information gained from this work in itself may be small, but without it the entire study of rock excavation becomes a mere matter of books and imagination. Many of the students work in mines during their summer vacations and thereby receive much better practical instruction than can be obtained in any laboratory. Such men may be given credit for this work. Students who have worked at mucking jobs for one or two summers are glad of the opportunity to run a drill in the school mine in the hope that the experience may aid them in securing something better than a mucker's job the following summer."

Among the advantages of the experimental mine at the Missouri institution is one that was not foreseen in the beginning. This is its use for practical instruction in mine surveying. Until the shaft was sunk in 1921, the property was not considered large enough nor varied enough to serve for this purpose. The custom was for the class to make a trip to a coal mine in Illinois or to a lead mine in southern Missouri. Since the average cost for this was $50 per man, and the class usually numbers about 50, the experimental mine has made possible an aggregate saving of $2,500 a year in student expenditures.

When giving instructions in surveying, the class is divided into pairs, each of which consists of a man to run the instrument and of a helper. The operations are repeated, using different stations and with the positions of the men reversed, so that all are given diversified training. Each party plumbs the shaft with two wires and also runs a line down the shaft using the top telescope. Since each man makes a complete survey and map and does his work in a small squad that allows close supervision, the practical benefits derived from the course are considered much superior to those secured during a hurried trip to one of the commercial mines.

The workings in the school mine now total about 600 feet; and the equipment is in line with that found in real mines. Steam power is furnished by a 125-hp., horizontal, return-tubular boiler. One of the compressor units is an Ingersoll-Rand Imperial Type 10. There is a 35-hp. Erie engine that is used to run the crushing machinery. Boiler-feed water is pumped from a near-by stream, except in times of drought when it is obtained from a 160-foot well by means of air lifts. For drilling, BCR-430 and BCRW-430 "Jackhamers" are employed, as well as Leyner-Ingersoll drifters. Drill steels are reconditioned on a Leyner sharpener.

Somewhat similar to the mining laboratory just described is the one maintained at the University of California, at Berkeley. Like the property at Rolla, it consists of an adit from which suitable openings have been driven. The property is known as the Lawson Adit, in honor of Prof. Andrew Lawson formerly dean of the Mining College. The opening was driven in sandstone and serpentine for a distance of 250 feet by two Cornish miners who had put in years in the Grass Valley and Comstock mines. Timbering of various types was placed for instruction purposes; and then the mine was turned over to the students for study.



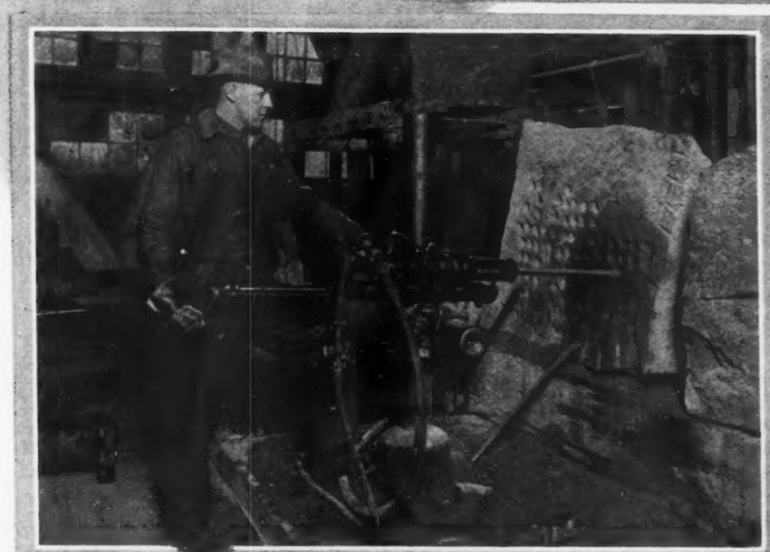
The Lawson Adit, the experimental mine of the University of California.

Left—Where the students get first-hand knowledge of the different kinds of timbering used in mining operations.

Right—The "shifter's" room.

Bottom—Edwin P. Willoby, for 25 years in charge of practical mining at the school, drilling a test block of granite with a BCR-430 "Jackhamer".

The time spent in the underground laboratory is optional with the students. Mining operations are under the supervision of two members of the faculty. Rock drills of both the drifter and "Jackhamer" types are used. Compressed air is piped from compressors in the basement of the Hearst Mining Building, which is adjacent to the adit portal. Classes in mine-surveying utilize the workings; and each spring practical training in mine rescue work is conducted under the direction of United States Bureau of Mines' representatives and of faculty members. After the



Upper left—Adit portal and surface equipment of the experimental mine maintained by the Missouri School of Mines, at Rolla. Other photographs show student-engineers of the Ingersoll-Rand Company getting practical training as drill runners above and below ground at Phillipsburg, N. J.

students have been taught first-aid measures and have been drilled in the adjustment and the use of the emergency apparatus provided for coping with mine disasters, they are given a realistic bit of experience. The adit is filled with smoke, and the men proceed to don gas helmets and inhalators and to explore the workings under conditions approximating those prevailing in a mine that has suffered a fire. Within the adit, the embryo mining engineers are taught how to throw up bulkheads designed to check the spread of flames and to permit the smoke to be cleared from the workings by currents of ventilating air.

A typical group of Ingersoll-Rand student-engineers whose shop experience is rounded out by practical instruction in the company's experimental mine.

The Colorado School of Mines uses actual mining properties for instruction purposes. At Idaho Springs, where the original Rocky Mountain gold discovery was made by Jackson in 1859, the school has leased the upper workings of the Edgar Mine. The property is reached through the Miami Tunnel, which cuts the vein 1,950 feet in. Extensive workings have been opened up in following the mineral deposits; and there is a connection with the Big 5 Tunnel which penetrates 10,000 feet into the mountainside and reaches some of the ore zones of the adjacent Gilpin County mining district. On ground close to the Miami Tunnel portal, the school has erected three buildings that provide an office, drafting room, vault for surveying instruments, washroom, blacksmith shop for sharpening drill steels, and space for storing drills and other equipment.

Not only can full use be made of the Edgar workings, but the students have the privilege of surveying and studying the Big 5 Tunnel and the Argo or Newhouse Tunnel, which is 21,968 feet in length. They also are given the opportunity of visiting and inspecting other mines in the section. There are more than 80 of them, as well as some 15 mills. The district has produced to date ore valued at more than $90,000,000. The principal minerals are gold and silver, with incidental values in lead, copper, and zinc. The typical occurrence of ore is in fissure-type veins in metamorphic rocks—the deposits usually being associated with dikes.

Thorough practical training is given in all phases of mine surveying. In addition to the underground facilities, the surface topography is favorable to instructions in mineral-land surveying. Lode claims are laid out with discovery shafts on actual veins and tied in with government section corners, mineral monuments, and triangulation stations. Adjacent to the mine is Clear Creek—the flanking ground being admirably suited for practical work in placer and mill-site surveying. Conditions in the workings are satisfactory for mine sampling and valuation work in mining geology, as well as for all actual mining operations.

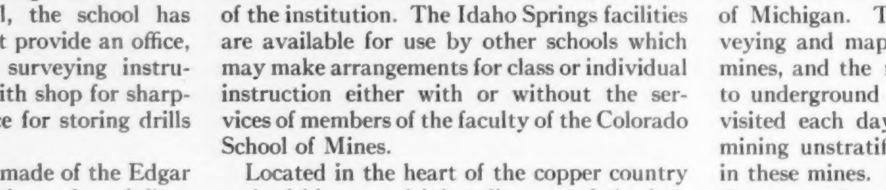
All students are required to spend several weeks on this phase of their education. The mine is about 25 miles from Golden, the seat of the institution. The Idaho Springs facilities are available for use by other schools which may make arrangements for class or individual instruction either with or without the services of members of the faculty of the Colorado School of Mines.

Located in the heart of the copper country and within easy driving distance of the iron districts of the state, the Michigan College of Mining and Technology is ideally placed for the teaching of mining engineering. The shafts of the Quincy Mine are in full view of the campus; the Isle Royale Mine is located on a hill immediately above the college; and the mines of the Calumet & Hecla and the Copper Range companies are within a radius of ten miles. This accessibility, together with the fact that students may visit the mines at any time, has determined the method of instruction at the college—in fact, some of the courses are a direct result of the facilities and opportunities available.

The freshman classes are taken on trips through the copper mines in order that they may have a background for their studies. The school is provided with models showing almost all the methods of mining employed in the region—the models, in many cases, depicting actual sections of individual mines. Before taking any trip the students, with the aid of these models, study the particular method used in the mine to be visited. In this manner theory and practice are combined.

During the second year, methods of mining unstratified ore deposits are studied from textbooks and models; and in the following summer five weeks are spent in the iron mines of Michigan. Ten days are devoted to surveying and mapping a portion of one of the mines, and the rest of the time is given over to underground mining. A different mine is visited each day. Almost every method of mining unstratified ore deposits is employed in these mines. Consequently, at the close of that year, the student has an excellent background for the more advanced courses of the third and fourth years during which he studies mine examination, valuation, reports, equipment, and development. The material he has already obtained serves as a foundation for these studies, and additional trips are taken to both copper and iron mines for the purpose of obtaining fresh information about surface plants and arrangements.

Both the copper and iron mining companies of Michigan coöperate with the college in every way possible. Not only are the classes allowed access to all the iron mines and most of the



Where students of the Colorado School of Mines live while gaining practical experience in the mines near Idaho Springs, Colo.

copper mines but, generally, the mine superintendents and engineers personally conduct the trips and explain the methods in use and the factors controlling them.

The College of Mines of the University of Washington, at Seattle, formerly maintained an experimental mine, but as it was not of a suitable character it was abandoned. At the present time the students use a drift-shaped opening, built of very heavy concrete, to familiarize themselves with the action of rock drills and to test new types of drilling equipment. Virtually all the undergraduates receive practical training by working in mines during summer vacations. Since the City of Seattle is built on glacial drift and excavations are continually being made for subaqueous tunnels and foundations, special opportunity is afforded students to study methods of working in soft ground.

The maintenance of mining laboratories of the character described is not confined to colleges. The United States Bureau of Mines has from time to time reproduced, on a small scale, underground workings of various types for the purpose of studying specific problems that have been referred to it by technicists. At the time engineers in charge of the new Holland Tunnel under the Hudson River were seeking information which would enable them to determine the required capacity of the ventilating system, government experts supplied much helpful data by introducing varying amounts of carbon monoxide and other gases into the workings of an experimental mine and noting what quantities of fresh air were needed to render the atmosphere harmless to human beings. These tests were conducted in the bureau's established experimental mine near Pittsburgh, Pa., from which has emanated a vast amount of information of value to the mining industry.

A large manufacturer of compressed-air equipment—the Ingersoll-Rand Company—uses an experimental mine at its Phillipsburg, N. J., factory for a variety of purposes. It is in service so much of the time that an engineer is always on duty there to operate the hoist and to look after the surface equipment. The property consists of a 100-foot vertical shaft with levels at 50 and 100 feet, and of an extensive system of drifts and crosscuts 8x8 feet in section. The mine was opened up fifteen years ago. The rock is sedimentary in character; and, because of the presence of small quantities of water, the material drilled varies from mud through shale to hard limestone. Since this results in difficult drilling conditions, the mine serves admirably as a testing and proving ground for the various types of rock drills that the company makes. Every new model developed in the shops is subjected to rigorous and prolonged service in this mine so that any faults or shortcomings may be revealed and corrected before the new type of drill is added to the list of standard products.

The mine also is of educational value. Student-engineers who are recruited from the world's leading technical schools undergo a period of training in the company shops to learn all about I-R products and the details of their manufacture. This schooling is as practical as it can be made, and includes actual manual work in the various plants and departments. The mine is used as a sort of laboratory where these men learn to operate drills under a wide range of conditions. Besides, the student-engineers are taught how to make drill steels—the mine serving as a place where they can try out the products of their workmanship.

To maintain its shop force at a high standard of excellence, the company has in training most of the time a group of apprentices. Many of these have never been in a mine prior to their employment. In order that they may gain a clear conception of what the products they help to make must do in actual service, these shop workers are given instruction in drill running and shown the importance of exacting practice in manufacturing drills. Thus the experimental mine is an important factor in aiding the Ingersoll-Rand Company to maintain the high quality that characterizes its "Jackhamers" and other well-known types of hammer drills.

HUGE SETTLING BASIN FOR PORT OF TIENTSIN

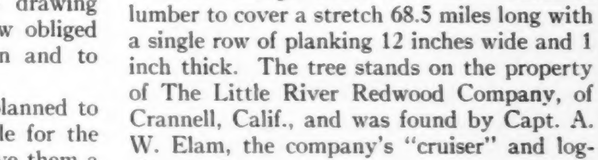
THE future of Tientsin as a port of call for ocean-going freighters is to be assured by the construction of a great settling basin that is designed to prevent the silting up of the Hai Ho on which that Chinese city is situated. Under present conditions, vessels drawing 17 and more feet of water are now obliged to unload 40 miles below Tientsin and to lighter their cargoes up the river.

To keep the channel clear it is planned to divert certain tributaries responsible for the silting up of the Hai Ho, and to give them a chance to rid themselves of their burdens of suspended solid matter before emptying into the main stream. The basin for this purpose is to be built on what is now marshland north of Tientsin—the entire project, including suitable locks and a 15-mile canal, involving an expenditure estimated at $2,000,000.

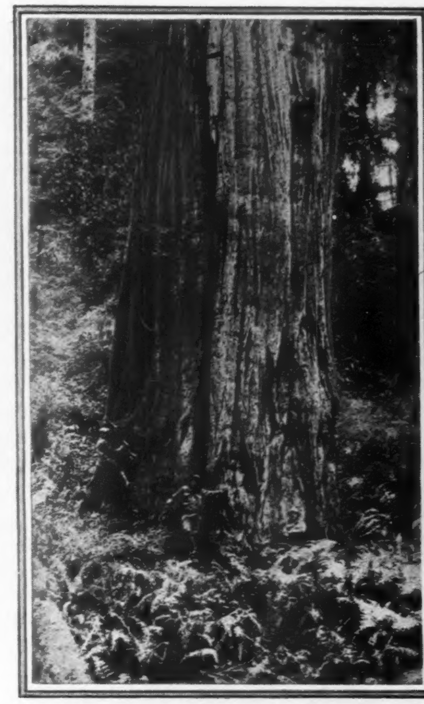
NEW HIGH-PRESSURE BLOW GUN

THE pneumatic Economy Blow Gun, shown in the accompanying illustration, is a new product of the Schutte & Koerting Company of Philadelphia, Pa. It is operated with compressed air on the jet principle and, as its name implies, is said to be very economical in the use of power, reducing the consumption of high-pressure air, in contrast with other types, approximately 50 per cent.

Control of the compressed air is effected by a button set in a small cup on top of the gun. When this button is depressed, the air passes through an inner nozzle before it is discharged in the form of a high-velocity jet which entrains atmospheric air entering through side ports in the gun. The Economy Blow Gun is recommended for dusting or cleaning machine tools and electrical or any other equipment requiring compressed air.



Arrows back of nozzle indicate the side ports through which atmospheric air is sucked into the gun and admixed with compressed air.



This giant California redwood contains sufficient sound lumber to build, complete, 22 homes of average size.

A LUMBERYARD IN ITSELF

THIS towering *sequoia sempervirens*, more familiarly known as California redwood, contains enough board feet of marketable lumber to cover a stretch 68.5 miles long with a single row of planking 12 inches wide and 1 inch thick. The tree stands on the property of The Little River Redwood Company, of Crannell, Calif., and was found by Capt. A. W. Elam, the company's "cruiser" and logging engineer.

As a challenge to a statement appearing in an Australian paper to the effect that a certain eucalyptus in that country contained more commercial wood than any other known tree the world over, The Little River Redwood Company had its *sequoia* carefully measured with calipers and other instruments—thus indisputably taking the palm of supremacy from the Australian giant of the forest.

Unfortunately, the figures for the eucalyptus are not given, but the redwood stands 308 feet high and has a total diameter 5 feet above the ground of 20 feet—the bark being 22 inches thick. The tree, making due allowance for loss in falling, will yield 361,366 board feet of lumber.

New South Wales Building Big Floating Dock

NEW South Wales, Australia, has recently given striking evidence of her self-sufficiency in the matter of fabricating large steel structures. In this particular case she produced at Walsh Island, Newcastle, the middle section of a new floating dock. At the time of launching, the section represented a total weight of 2,500 tons—being 205 feet in length and 113 feet in width. The dock, as now planned, will be composed of three sections and will be able to accommodate the largest steamship now trading with Australia.

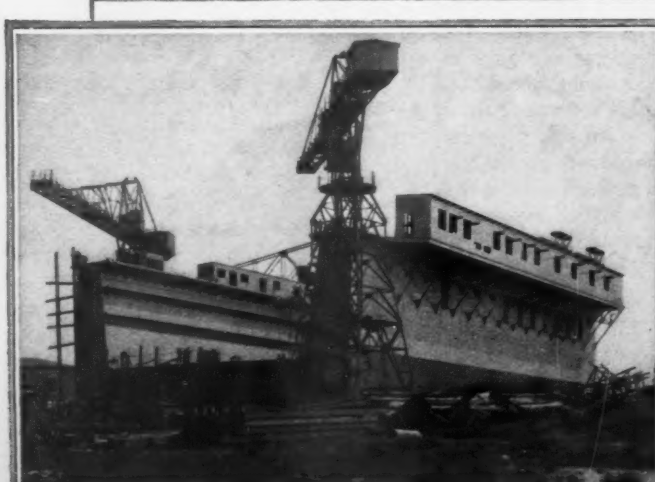
Aside from giving New South Wales this invaluable aid to the upkeep and maintenance of shipping entering her waters, the construction of so large a floating drydock marks a significant industrial departure. It is well within the memory of many of us that large drydocks of this character have, in the past, pretty generally been built somewhere in the British Isles and then towed many thousands of miles to their intended places of service. The towing of these docks involved many hazards and imposed upon strictly harbor craft—for such floating drydocks are—the making of long sea journeys in the face of more or less tempestuous weather. To render them halfway seaworthy, special provisions of a temporary nature had to be installed; and even so the drydocks represented troublesome bodies to be moved in the open ocean and to be navigated when winds blew and strong currents were encountered in relatively constricted waterways.

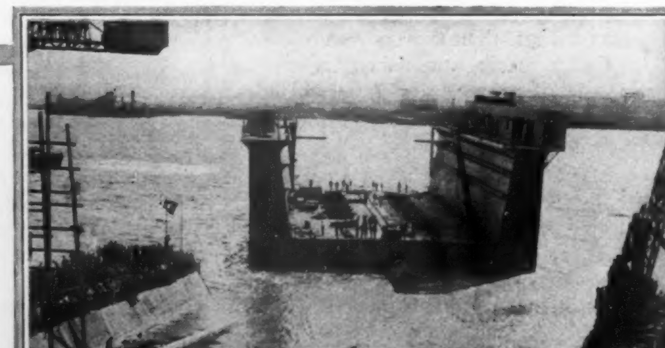
New South Wales, in constructing this large floating dock, has thus initiated a departure that obviates the risks of a long voyage and, incidentally, shows the colony's capacity to meet conditions that might arise. For instance, the dock is essentially planned to take care of shipping in times of peace; but a dock of this sort is flexible inasmuch as it can be readily enlarged to handle big fighting craft. For example, by adding a fourth section to the dock it will be practicable for it to accommodate a fighting ship of 18,000 tons. The plant at Walsh Island having proved equal to the present job should have no trouble in building a fourth section should circumstances call for it. The three sections of the dock are expected to be finished and ready for service by September of the current year.

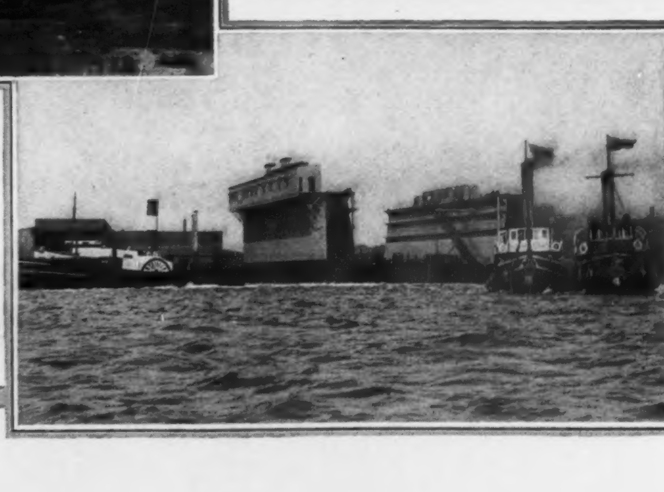
The floating drydock is, relatively speaking, a modern invention. It is mobile, inasmuch as it can be towed from point to point, and, if necessary, can actually be moved to a ship in need of docking instead of requiring the disabled craft to seek the dock. While this is an unusual procedure, still it exemplifies the adaptability of the type—in this particular being absolutely unlike the graving dock which, to express it in simple terms, is a great hole in the ground and, therefore, stationary. Not only that, but a graving dock can be entered and left only at certain stages of the tide, while a floating dock can be so placed or stationed that it can be utilized any time.

The Walsh Island dockyard is doing an excellent job in turning out the floating-dock sections; and it is easily understandable why the launching of the big central section was made an occasion of ceremony and much public rejoicing. At the time of launching, the sponsor broke a bottle of champagne upon the dock, and said: "I break this bottle of wine to wish success to this floating dock, to congratulate those who have built it, and to express the hope that it may lift many ships in times of peace and, if necessary, serve in time of war."

The Walsh Island dockyard has an up-to-date compressor plant; and pneumatic tools are being used extensively in building the floating drydock.







Left—Middle section of the great New South Wales floating dock ready for launching.

Right—The middle section just after leaving the launching ways.

Bottom—Tugs towing the newly launched floating-dock section back to the building yard at Walsh Island.

Compressed Air Used to Unload Bulk-Cargo Craft

By S. G. ROBERTS

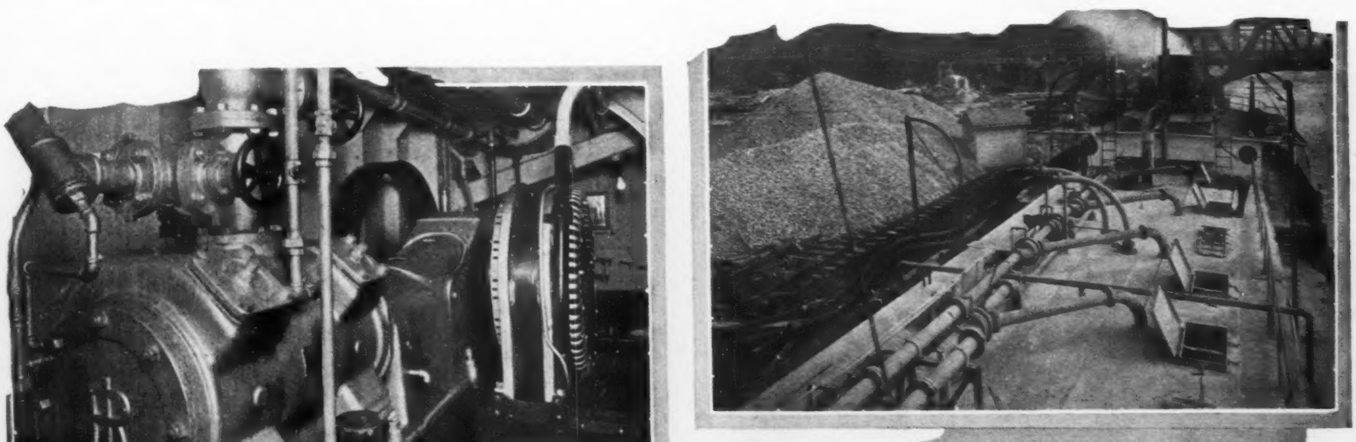
THE Merchandise Mart is the designation that has been chosen for a monster building that is now in course of construction on the Chicago River, in Chicago, Ill. The Merchandise Mart, when finished, will have eighteen stories with an average of something over 200,000 square feet of floor space on each floor, or a total of approximately 4,000,000 square feet in the stories mentioned. The front center of the structure will be distinguished by a tower effect that will rise five stories higher than the rest of the building and add just that much to the space available within this monumental edifice that will be devoted to business uses.

Subsurface conditions within Chicago have led to the development of a somewhat specialized system for the supporting of massive structures; and this, in the main, consists of numerous more or less closely spaced concrete pillars or piles penetrating the earth far enough to insure a firm footing upon hardpan. In the case of the Merchandise Mart, the foundation contractor will be obliged to construct a total of 472 of these reinforced-concrete columns; and ground conditions on the site necessitate carrying these supports down to a depth of 80 feet below the city datum, at which point hardpan is encountered.

In order to carry the columns down to the desired stratum, what is known as the Chicago method of excavating is employed. This method entails the digging of circular shafts which are lagged at suitable short intervals and reinforced with rings of steel. The caissons for the Merchandise Mart will vary in diameter between 5 feet 8 inches and 10 feet 4 inches—depending upon the individual load carried by them. The actual excavating is done by men equipped with air-driven clay diggers. The 472 caissons will call for a total of approximately 45,000 cubic yards of concrete. So much for the use of this material in providing the needful supporting ties between hardpan and the basement structures. Concrete will be employed extensively in the construction of the Merchandise Mart, which is said to be the largest business building now being erected.

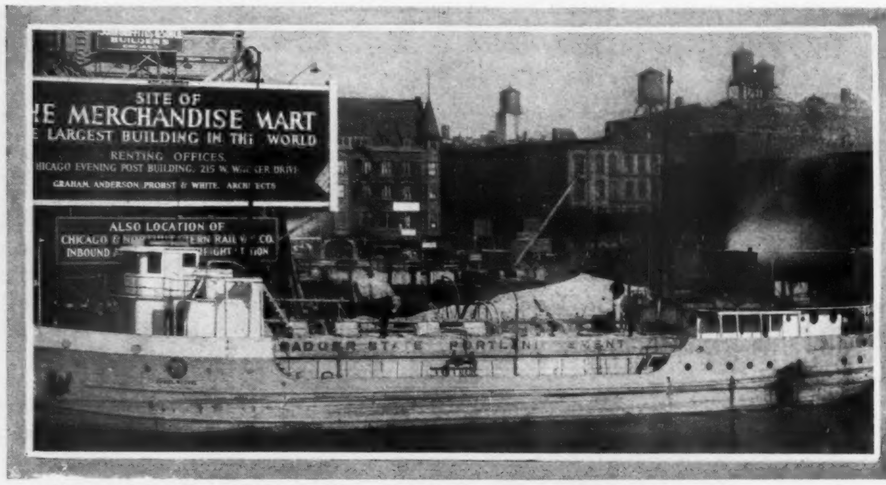
In sinking the caissons, the work is being done in groups of from 15 to 30, and operations have been so timed that an average of seven caissons have reached hardpan daily. This, of course, has required the mixing and placing of large quantities of concrete every 24 hours; and it also has necessitated the maintenance of an ample supply of cement for this service. The primary problem, therefore, was to find an economical way of delivering the cement in bulk at the rate of 2,000,000 pounds at a time, and to accomplish this with a minimum of handling and, likewise, expeditiously.

The first evidence of how this was to be done, so far as the general public was concerned, was revealed when the motorcraft *Daniel McCool* appeared in the Chicago River early last fall and tied up alongside the site for the Merchandise Mart. The *Daniel McCool* then carried a cargo equivalent to 4,200 barrels of cement stored loose or in bulk in six capacious bunkers, three on each side of the vessel's hold. These bunkers have the form of hoppers, which are filled through hatches in the main or weather deck. Before describing the way in which the boat discharges her cargo it might be well to give some of the details regarding her.



Left—One of the two motor-driven Ingersoll-Rand compressors that furnish air for the unloading system. Right—Looking aft on the weather deck of the motorship "Daniel McCool", showing the deck piping of the unloading system as well as the open hatches through which the vessel is loaded at the cement plant. Bottom—Looking forward along the weather deck of the "Daniel McCool" showing the connecting pipe lines through which cement is being moved and lifted pneumatically to the storage bin at the right.

The *Daniel McCool* was designed in 1926 by Charles C. West, who is president both of the Manitowoc Shipbuilding Corporation and the Manitowoc Portland Cement Corporation—the motorship being constructed for the cement company. Both concerns are Wisconsin enterprises. The *McCool* is a steel craft 157 feet long with a beam of 33 feet and a net tonnage of 378 tons. She is equipped with twin screws driven by two Fairbanks-Morse Diesel engines, each of 240 hp. When light the boat can make 11 knots, and when loaded her maximum speed is 10 knots an hour. Direct connected to each oil engine is a generator capable of producing 3-phase current of 480 volts. These generators provide operating current for various electrically driven auxiliaries. Among these auxiliaries are two ER 12x10-inch Ingersoll-Rand air compressors, each of which is driven by a synchronous motor. The compressed air so supplied is used in discharging the *McCool's* cargo of bulk cement.



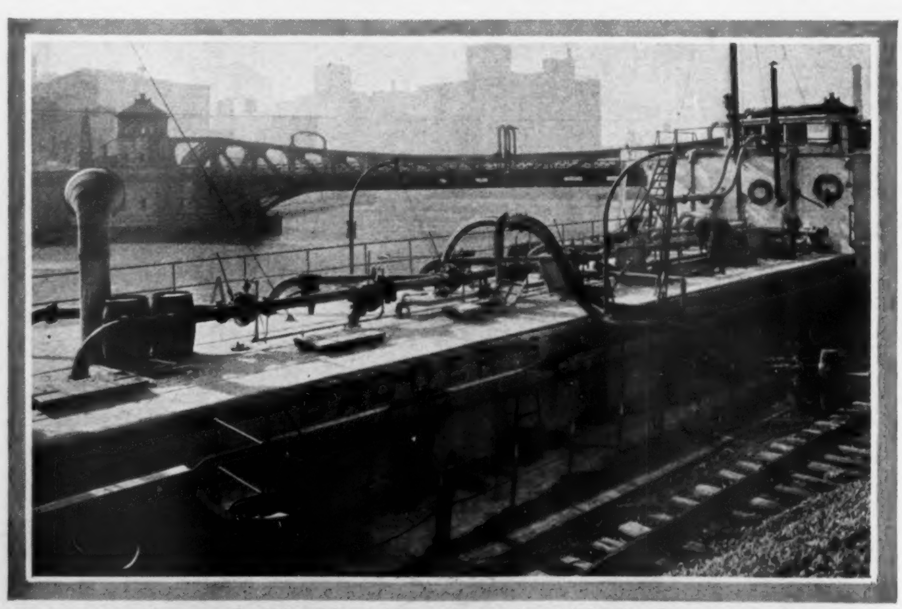
Motorship "Daniel McCool" unloading a cargo of bulk cement by means of compressed air.

Since her launching, the *McCool* has visited Chicago on numerous occasions, carrying cement to the Manitowoc Portland Cement Corporation's stock house which is situated on Fullerton Avenue—the cement being afterwards moved by truck to various points in the city where needed. Her arrival at the Merchandise Mart site represented a departure in service and, incidentally, disclosed the adaptability of such a medium of transportation.

The loading of the *Daniel McCool* at the plant of the Manitowoc Portland Cement Corporation, about 160 miles due north of Chicago, takes virtually sixteen hours under the extremely favorable conditions prevailing there, and at Chicago the time required to discharge her cargo ranges between 7½ and 8 hours. Even so, this is rapid work in handling an amount of cement that would fill 4,200 barrels.

The method of discharging the cement is a comparatively simple procedure. The cement falls by gravity from the hopper bins and is fed through gates, in the bottom of the bins, to a conveyor system, running lengthwise of the boat, in which a horizontal screw moves the cement to a pipe line where the material is caught up by an air jet under a pressure of 60 pounds per square inch. There is a screw conveyor for the bins on each side of the vessel, and each of these lines has its own air-jet connection. Flexible 5-inch pipes carry the air-impelled cement from the motorship to a storage bin 125 feet away and placed 75 feet higher than the deck of the vessel. The prime movers in this novel installation are two 8-inch Fuller-Kinyon pumps; and one of the purposes of the compressed air is to break up and to aerate the cement so that it can be fed by the pumps through the discharge line. The system provides a simple and a virtually dustless means of handling bulk cement and kindred commodities.

If all the supporting reinforced-concrete columns for the Merchandise Mart were placed end to end they would cover a distance of nearly 6½ miles; and in forming these pillars a total of quite 100,000 barrels of cement is required. This, in brief, has been the special job of the *Daniel McCool*; and she has demonstrated convincingly that she is peculiarly suited for just such tasks.



Here we see the two flexible 5-inch lines through which the dry cement is conveyed by compressed air from the hold of the vessel to a storage bin 75 feet higher and 125 feet away.

KNOTTY LUMBER MAKES STOUT BOXES

EXPERIMENTS at the United States Forest Products Laboratory have proved that knotty lumber will make a box with short, thick sides that is more resistant to rough handling than one of clear lumber provided the boards have a slenderness ratio—length divided by thickness—less than 60. The laboratory's tests showed that clear boards are not flexible enough when subjected to rough handling to absorb the shocks produced by the box contents and to relieve the direct pull on the nails.

It is recommended that the size of any one knot in a board used for this purpose should not exceed one-third the width of the board, and that the aggregate diameter of all knots within a length equal to the width of a board should not exceed the diameter of the largest knot allowable. Other advantages from the employment of knotty lumber in boxes are its lower cost, as compared with clear lumber, and the fact that its utilization provides an outlet for low-grade lumber.

EFFECT OF PAINT ON HEAT RADIATION

HOUSEHOLDERS that want to get the most out of the fuel burned in their furnaces should be interested in the following facts given out by the American Society of Heating and Ventilating Engineers regarding the effect of paint on radiator performance.

To determine this, tests were made with two identical radiators, which were arranged to operate at the same time and under the same conditions. One of them was left unpainted to serve as a standard of comparison, while the other was coated successively with the different kinds of paint being investigated. Each radiator had its own electric boiler that supplied saturated steam at constant pressure.

The results indicate that only the last coat affects the heat emission. Considering the performance of the bare radiator as 100, the painted radiator rated as follows: Liquid gold, 92.6; aluminum, 93.7; white-gloss enamel, 102.2; flat-tone cream, 104; and flat-tone brown, 104.8.

Industrial Cars Perform Numerous and Varied Services

Because of Their Many Fields of Usefulness Industrial Cars Are of Divers Designs and Capacities

By A. S. TAYLOR

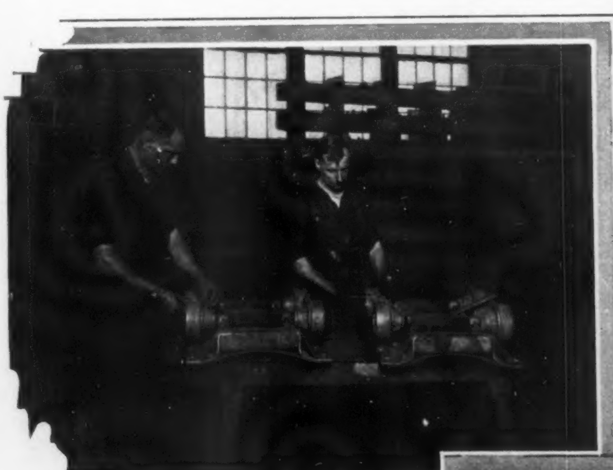
WHY are and what are industrial cars? Industrial cars are different from railway cars. Both kinds of cars may run on rails and both may serve industry; but, even so, there is a radical difference in the service performed by each.

Railway cars are the transporting mediums that traverse the main circulatory system of the country's freight-handling routes. Industrial cars, on the other hand, make far shorter runs, are much more circumscribed in their movements, and are, as a rule, immediately identified with the operations of a quarry, of a mine, of a manufacturing establishment, or tributary to some construction or engineering undertaking. In brief, they are the capillaries of the nation's freight-handling system—using the term in the widest sense.

Expressed in another way, industrial cars do not have to travel on standard-gage tracks. They may be built to run on tracks of any convenient gage so as to meet any particular need or service. Furthermore, industrial cars are not restricted to the prevailing conventional capacities, because they can be constructed to handle any load from that weighing a fraction of a ton to burdens amounting to 100 tons and more. Industrial cars may be equipped with automatic couplers and air brakes, if such be desirable, or their field of employment may be of a nature that calls for neither of those fittings.

Indeed, industrial cars may not inappropriately be described as the domestic servants of industry—each kind performing the special work called for in each household, so to speak. And because industrial cars fit into these various fields of endeavor they are more or less what might be designated as tailormade products—that is, they are of such design, of such size, and so equipped as best to meet the demands of each of many fields of usefulness. Cars of this sort are turned out in response to orders that may call for anywhere from 1 to 100 of them. Finally, industrial cars are not operated for tariff or revenue, as the term is usually understood in railroading; but, nevertheless, they do contribute to the profits of the concerns that utilize them because they enable those concerns either to make or to save money bv doing well some essential work.

Perhaps relatively few of us have noted how extensively industrial cars are employed; and it is safe to say that we have given little heed to their numbers and to the variety of things they do. There are thousands and thousands of industrial cars in use in this country today; and without them various indispensable operations would proceed much more slowly and, undoubtedly, at a greatly increased cost. There are industrial cars in plants or establishments where one would least expect them; and yet in every case they are contributing to volume of output and to



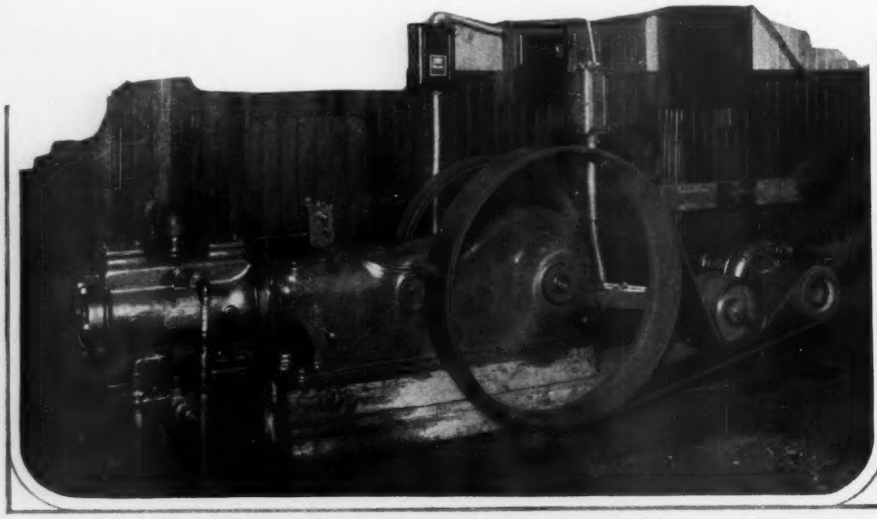
Left—Assembly of trucks for handling newsprint.

Right—Special drill rig devised for countersinking holes in heavy steel plates.

Bottom—Coal-charging car in the fireroom of a steam plant.

economy of operation. It would only bewilder the reader if we gave even a partial list of these services; and we have no desire to weary in our efforts to be informative.

Manifestly, a plant that is engaged in turning out industrial cars for such diversified purposes must differ in a number of respects from those shops that are devoted to the construction of the familiar standardized types of railway freight cars. Quantity production, as the term is understood in manufacturing, is not the primary aim in an industrial-car plant, because the shop equipment must be adaptable and not arranged fundamentally for rapid repetitive operations—it must lend itself to the changing demands of different types of cars. The purpose of this article is to tell something about a concern that is engaged exclusively in the building of industrial cars; and before our story is concluded the reader no doubt will have a better idea—if he were previously uninformed—of the many sorts of these vehicles that are turned out and of the manner in which they are fabricated.



One of the two Ingersoll-Rand compressors that supply air in the shops of the Easton Car & Construction Company.

The Easton Car & Construction Company, of Easton, Pa., was granted its charter in February of 1914; and, therefore, it has been in its chosen line of business for a decade and a half. What the company has done in that interval has made it known not only the country over but the world over; and no small part of this desirable standing is due to what the company has done in developing industrial cars especially suitable for quarry work. Quarry cars have to be able to stand a great deal of rough treatment in carrying rock from the quarry face to the crushers. It is, therefore, indispensable that such cars combine the utmost ruggedness with efficient operation. The company has been influenced in this department of its work by the situation of its plant in Easton, where it is near the heart of a section of Pennsylvania in which enormous quantities of rock are quarried either for the manufacture of cement or for the production of crushed stone for many uses.

The company's patented Phoenix car, which is very widely employed, is one evidence of this specialization. For the sake of handiness, cars of this sort dump from either side—power being utilized to tip them; and the cars are robust enough to stand up well under the wracking impacts of shovel loading. Any quarryman will recognize what this means. Furthermore, cars for such work must combine adaptability with endurance so that they can meet the changing conditions incident to hauling stone from the quarry face to the crushers. All day long, day in and day out, trains of these cars move back and forth—often over hastily laid track and always subjected to rigorous treatment. But for the way industrial cars of this kind stand up to the service required of them, all of us would probably have to pay considerably more for our cement and our broken stone.

It is not difficult to conceive how the principles and the structural practices that have proved so successful in the building of quarry cars should be found equally valuable in turning out cars for allied rock-handling services—for instance, in many forms of mining and in numerous kinds of engineering undertakings. In mines, the ore, the coal, or the mineral of any sort must be moved from the heading—often fairly long distances—to the portal or to the ground surface for disposition; and this mucking or tramming must be done expeditiously, and the cars must be capable of moving upon rails of gages suited to the working passages in which the tracks are often laid upon uneven ground and subject to frequent shifting.

Similarly, many of the conditions that apply to mining are duplicated in the driving of railroad and water tunnels, or in doing various kinds of construction work necessi-

Main shop of the Easton Car & Construction Company, Easton, Pa., with office building at right.

1—All frames are spray painted before the cars are finally assembled. 2—Riveting up a steel concrete hopper car. 3—Reaming holes in the bottom of an Easton industrial car with an air-driven drill. 4—An I-R air hoist handling steel plates at a bending machine. 5—A riveting gang at work on the body of a steel dump car.

tating extensive excavations and the making of possibly equally large fills. The problem in any one of these cases might easily entail the moving of thousands of cubic yards of materials; and in some of these undertakings the industrial cars have their most spectacular applications.

As a matter of fact, pretty nearly every sizable industrial plant does much of its moving, inside and even outside of the plant, on cars built especially for it. We find this so frequently the case in iron and steel mills, in foundries, and in a great many other places where large quantities of hot metal have to be shifted from shop to shop or from department to department during different stages of production. It is an axiom in such plants that it costs something to move anything any distance—no matter how short. Therefore, special facilities that will make it possible to do this with the least expenditure of time and power, and with the least confusion, are recognized as indispensable. The industrial car is one very helpful means to this end.

Most of us have seen concrete cars in action carrying loads of concrete from the mixers to points where the stuff is dumped into forms or into chutes leading to forms that are out of sight. Concrete cars are modeled to suit working conditions and the load to be moved in each case. A logical variation of these cars can be found in scoop bodies and dump bodies of different kinds—made for end dumping or side dumping—which are mounted on motor trucks and used for the transporting of ready-mixed concrete and such other materials as may be needed in construction work.

A form of industrial cars, classed as transfer cars, has a diversity of applications. Transfer cars are low flat cars with rails on top so that other cars can be wheeled on or off of them. Cars of this sort are built to handle transformers in electric-car stations, and are used in removing transformers for overhauling or for replacement. Transfer cars are also utilized in brickyards, cement-block plants, etc.

Industrial cars are now employed in certain up-to-date newspaper plants to carry the heavy and awkward rolls of newsprint. These cars facilitate the shifting of the rolls from the storeroom to the presses, and obviate tipping the rolls on their ends, with the consequent risk of crushing and damaging the paper. The cars used for this purpose have brought about marked operating economies.

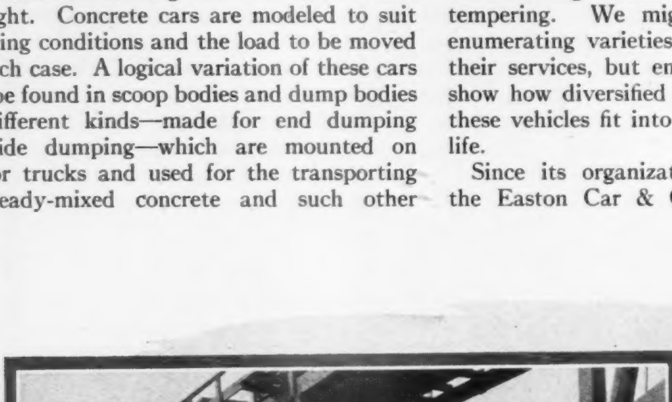
In large power plants, coal-charging cars have been found time- and labor-saving; and core-oven cars are universally used to carry the cores while undergoing drying or baking. Similarly, all-metal industrial cars are utilized to hold steel products while in the furnaces for annealing or heating preparatory to their tempering. We might go on indefinitely enumerating varieties of industrial cars and their services, but enough has been said to show how diversified are the ways in which these vehicles fit into our complex industrial life.

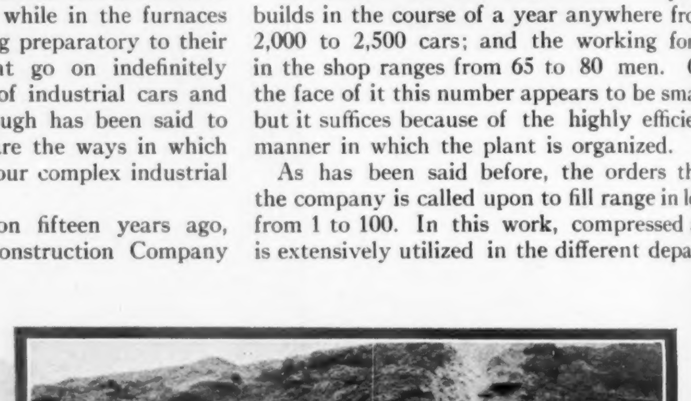
Since its organization fifteen years ago, the Easton Car & Construction Company has steadily broadened its field of service and amplified the classes of cars built by it—the foregoing particulars merely describing a few of its products. Apart from the originality of the company's designs, its work in the main consists in shaping, assembling, and fabricating materials and fittings for the most part obtained elsewhere. It buys all its castings, as well as its ball and roller bearings; and this situation leaves the organization free to devote all its skill to the final construction of cars capable of meeting the manysided demands of industry. The manner in which the company's products meet and satisfy these requirements is the best evidence of its success in a rather exacting department of steel construction.

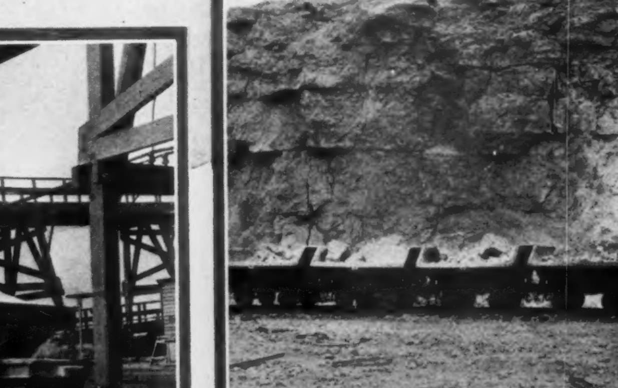
In addition to what are usually known as industrial cars, the company builds transporting equipment with flat-tread wheels which do not run on tracks; it constructs trailers with flat-tread wheels that can be drawn by tractors; and it makes what is known in the trade as "skids", with and without bodies of different types.

The Easton Car & Construction Company builds in the course of a year anywhere from 2,000 to 2,500 cars; and the working force in the shop ranges from 65 to 80 men. On the face of it this number appears to be small, but it suffices because of the highly efficient manner in which the plant is organized.

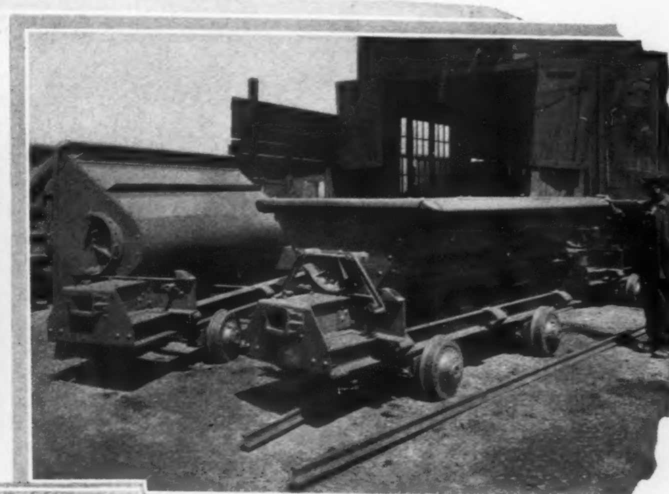
As has been said before, the orders that the company is called upon to fill range in lots from 1 to 100. In this work, compressed air is extensively utilized in the different depart-







Left—Gable-bottom cars.
Right—Phoenix cars in a quarry.
Bottom—Core-oven car in a foundry.



Left—Dumping position of a type of car built by the Easton Car & Construction Company.

Right—Showing upright and dumping positions of another type of car built by the same company.

Bottom—Side-dumping hopper car for handling concrete.

ments to lighten labor and to speed up production. For example, compressed air operates hoists, riveting hammers, reamers, and drills; and it is also employed in spray painting and in cleaning. The main air line in the shop carries a pressure of from 100 to 110 pounds; and the air is furnished by two compressors—one an ER-1 and the other an NE-1.

SAND BLAST CLEANS RAILS AND TIES FOR WELDING

THE sand blast is finding many fields of application outdoors in cleaning metal surfaces for one purpose or another. Thus, for example, when the San Antonio Public Service Company, San Antonio, Tex., undertook, not long ago, to recondition 2,000 feet of street-car track it was decided to discard hand tools for an air-operated sand-blast machine in doing certain cleaning operations.

The work involved the removal of all old tie bolts and clips and placing new ones in every other steel tie. This was accomplished by welding. To do a satisfactory welding job the rails and ties at those points had to be thoroughly clean, and here is where the sand-blast outfit, which was made in the shops of the San Antonio Public Service Company, was called into service. How effectually it operated can be gathered from the following statement from the maintenance department: "In one hour more and better work was done than was possible previously in eight hours with four laborers using chisels and wire brushes."

TUNG OIL NOW PRODUCED IN AMERICA

A NEW business venture has been started in the United States that promises to be a success and to make us less dependent on foreign sources of supply. We are referring to the production of tung oil, a base for paints and varnishes. Just how important an item of import this commodity is can be gathered from the fact that we obtained from China last year a total of 89,000,000 pounds valued at $11,809,583.

There has been erected and put in operation in Gainesville, Fla., what is said to be the first plant outside of China for extracting tung oil on a commercial scale. This plant is now turning out 40 gallons an hour, but is equipped to produce a gallon a minute. Working at that rate, and on the basis of a 20-hour day, the output would be equal to that of 1,000 coolies in China. The enterprise began in 1924, when 1,800 acres were planted with tung trees.

REINFORCED PAVEMENT FOR HEAVY TRAFFIC

A NEW patented pavement, designed primarily for city streets that must carry heavy traffic, has been used with success in England and is soon to be tried out in Paris on thoroughfares given over to autobuses and the like. These facts are from a recent issue of *Commerce Reports*, which goes on to say that "surfastal", as it is known, consists of a concrete foundation, about 6 inches in thickness, upon which is poured a ½-inch layer of asphalt. On this asphalt is placed a steel trellis composed of strips 1 inch high, ⅛ inch thick, and forming approximately 5-inch squares. To prevent displacement, each square is connected with those adjoining it by steel pins.

When this trellis has been set in place it is filled with asphalt or concrete, and the resulting surface is thus divided into a series of small squares bounded on each side by strips of steel. The material contained in each square extends under the framework to the contiguous squares and forms a homogeneous mass except for a depth of 1 inch at the surface where it is separated by the steel strips.

The framework, which is sufficiently flexible to conform to the contours of the foundation, becomes an integral part of the wearing surface with use; and the wear on the asphalt is said to be no greater than the wear on the edges of the steel strips. If it lives up to the claims made for it, "surfastal" would recommend itself for the floors of garages, loading and unloading sheds, in fact for the paving of any areas or stretches given over to the use of heavy trucks, buses, and the like.

A flexible rail for service in mines, quarries, etc., where temporary tracks must be laid from time to time, has been announced by the Illinois Power Shovel Company, of Nashville, Ill. The rail can be used wherever sufficient space is available.

San Diego's Dual System of Gas Transmission

Customers Remote from the Gas Plant Are Supplied by the High-Pressure Section of the System

By SIDNEY MORNINGTON

BLESSED with the bounty and colorfulness of favoring nature, with a romantic past and a very prosperous present, San Diego, Calif., makes an irresistible appeal to the visitor. That she has lasting charms is further evidenced by the large number of persons that permanently abide within her gates.

San Diego as a community dates back to 1769, when Junipero Serra, a Franciscan father, planted the Cross for the first time on the soil of "Upper California" and organized a mission that was to become a hallowed and a historical spot. With that as a beginning, twenty other missions were called into being at divers points along the northward trail of those spiritual pioneers. What California is today as a producer of fruits, vegetables, and flowers is, in the main, the consequence of the example set by those patient and resourceful priests who showed what irrigation could do in that region of abundant sunshine and fertile soil.

For years, San Diego scarcely attained numerically to the dignity of a village; and as late as 1867 the place held little more than a handful of inhabitants. Thanks to the zeal of a real-estate promoter, the town took a fresh start immediately thereafter; and by 1870 its population totaled 2,300 persons. Two years later San Diego was incorporated; and the year following she was made a port of entry. Some idea of what has happened since can be gathered from the fact that San Diego now has a population of 161,000 and possesses all the up-to-date features and facilities that usually go with a thoroughly alert community of that size.

According to those that record such data, San Diego has an average of 356 days of sunshine every year; she has fewer visitations of fog than any other city on the Pacific Coast—an hour or more of fog occurring, as a rule, not oftener than 22 times in the course of a twelvemonth; and the average difference between the mean temperature of one day and that of the next day is only 2°! The average summer temperature is 68° F., and the average winter temperature ranges but 8° lower. As someone has aptly expressed it: "San Diego uses the shortest thermometer in the world."

With climatic advantages of this distinctive sort; situated upon a picturesque and expansive bay, close to the rolling ocean; and fortunately placed where striking scenic charms meet the eye at every turn, there is little cause for wonderment that San Diego has won such outstanding favor. Thousands of people are drawn to San Diego during the winter months to escape the rigorous weather of the North and the East at that season; and in the summertime, other thousands travel from the hot interior sections of the country to San Diego for the reviving and refreshing breezes that sweep inland from the blue, sun-lit Pacific. For months running the neighboring beaches are thronged.

San Diego proper is the focal center of a number of contiguous and outlying communities—most of them dependent upon San Diego for supplies and essential services.

Top, left—One of the exhibition buildings in Balboa Park. Center—Modern bungalow in San Diego. Right—Spanish-type residence in Coronado. Bottom, left—Hotel del Coronado. Right—Looking over San Diego's civic center toward the harbor.

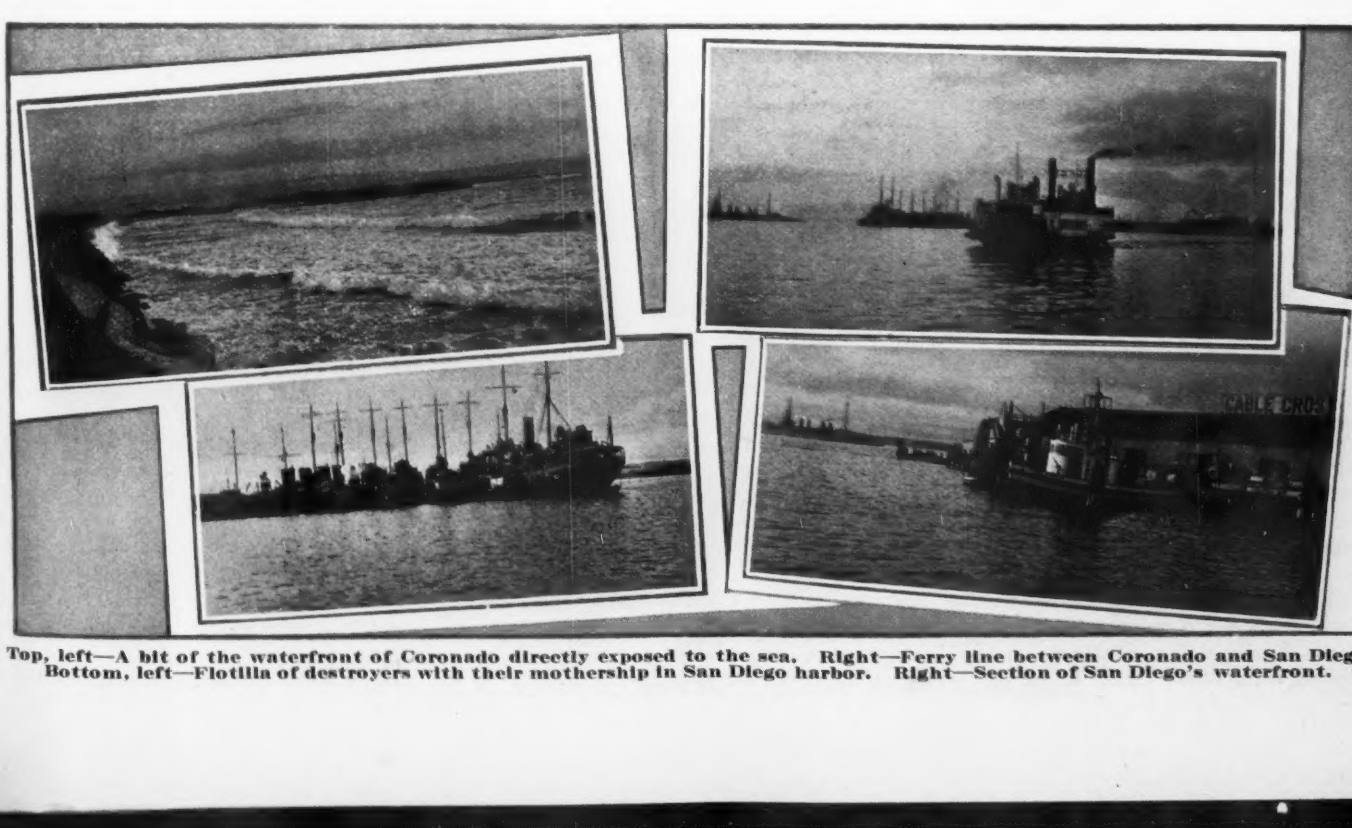
Left—Rugged coast line just north of San Diego.
Right—U. S. Marine Corps base at San Diego.

This is particularly true regarding the gas used well-nigh universally by them for heating and cooking. The Californian, where possible, finds it cheaper and certainly more convenient to warm his habitation with gas than with any other fuel; and the heating load is one of the big factors in public-service work. Even with her exceptionally equable climate—due to the nearness of the Japan Current, still there are days and nights in San Diego when artificial heat is needed to offset the chill indoors, and the gas radiator or the gas furnace meets the need admirably. San Diego's gas, as well as that used in outlying dependent communities, is supplied by the San Diego Consolidated Gas & Electric Company. The gas for this purpose is carried through pipe lines aggregating 783 miles; and the company has all told 55,000 gas customers.

The San Diego Consolidated Gas & Electric Company's mains extend twenty miles north, fifteen miles south, and about fifteen miles east of the plant. The territory beyond the city proper is so scattered that it would be uneconomical to try to deliver gas to the outlying districts except through a high-pressure system. The situation is emphasized by the continually increasing number of small communities that are springing up on the picturesque countryside; and all these places demand the typically modern convenience of gas for heating or cooking. Within a radius of three miles of the gas plant, the majority of the customers draw from the low-pressure mains; but within the city limits there are a few customers—governmental stations and industrial plants—that utilize gas at pressures ranging from 5 to 10 pounds. These are supplied from the high-pressure mains. The foregoing particulars are mentioned so that the reader may understand why the gas company is called upon to utilize two systems of transmitting gas to the points of ultimate distribution.

As is well known to those familiar with the subject, the number of customers per mile of main controls the choice of transmission system; and in the case of the San Diego Consolidated Gas & Electric Company, except within the populous part of the city's limits, there is an average of 66 customers to each mile of main. In the older or low-pressure system, cast-iron pipes ranging from 12 to 24 inches in diameter are used for transmission, while mains of from 4 inches to 8 inches in diameter are utilized for distribution. In the high-pressure or new part of the system, the transmission mains are of steel and vary in diameter from 4 inches to 12 inches, with 1-inch, 1½-inch, and 2-inch piping for distribution to the customers. The steel pipes carry pressures running from 15 to 60 pounds.

The method of control of the pressure of the gas delivered to the householder depends upon circumstances. In some cases a regulator or reducing valve is attached to the consumer's meter, while in the other cases the pressure is controlled by a district regulator and fed thence to groups of customers. Both the meters and the regulators are at times placed outside the customer's home. No matter what system is used to convey the gas through the feeder mains, the standard de-



Top, left—A bit of the waterfront of Coronado directly exposed to the sea. Right—Ferry line between Coronado and San Diego. Bottom, left—Flotilla of destroyers with their mothership in San Diego harbor. Right—Section of San Diego's waterfront.

livery pressure is that equivalent to a 7-inch water column. The high-pressure system is extremely flexible in that it makes it possible to take care of increasing suburban loads by merely augmenting the gas pressure without in any way adding to or changing the primary transmission system.

All the gas is manufactured from gas oil which is a fuel-oil residuum. At the present time, the company is producing daily 8,000,000 cubic feet of gas; and substantially 1,500 barrels of oil are required in manufacturing this quantity of gas. When the maximum heating load is added to the cooking load, the output exceeds 12,000,000 cubic feet of gas in the course of 24 hours.

The manufacture of oil gas is said to be a much less complicated procedure than that followed in the making of gas from coal. To the uninitiated, however, it appears that much skill is required even though the San Diego Consolidated Gas & Electric Company uses and is improving certain automatic control mechanisms that are uncanny in the many things that they have to regulate. Broadly stated, the fuel oil is gasified in retorts or generators that are brick lined and filled with refractory checkerbrick preheated to approximately 1,800° F. As by-products of each 1,000 feet of gas produced there are 20 pounds of lampblack and 3 pounds of tar. This lampblack and the residual tar are burned in combination under the plant boilers. This is somewhat astonishing, because the by-products carry quite 50 per cent. of water. Notwithstanding this, 1 pound of fuel is capable of evaporating 4 pounds of water in the boilers. This utilization of generator by-products lowers the cost of manufacturing gas from fuel-oil residuum.

The gas furnished the customers has 550 B.T.U's per cubic foot. After the gas leaves the generators it is passed through the usual washers, scrubbers, and purifiers, and then it goes through oil scrubbers to remove, by absorption, any contained naphthalene. From the naphthalene scrubbers, the gas goes to storage holders from which it is delivered to the compressors preparatory to sending it to the feed or transmission mains.

The compressor plant of the San Diego Consolidated Gas & Electric Company consists of six units—two of which are steam driven and four motor driven. To be specific, each of the steam units is capable of handling 120,000 cubic feet of gas per hour; and the motor-driven units are as follows: one of 370,000 cubic feet, one of 450,000 cubic feet, and two each of 270,000 cubic feet. All six compressors are Ingersoll-Rand machines. The gas is cooled and dehydrated, after leaving the compressors, by passing through tubular heat exchangers. The temperature of the gas as it enters the line is 65° F.; and, by removing the moisture from the gas, corrosion of the pipes is lessened proportionately.

The chemical laboratory in the gas works is an important part of the plant. Not only is the gas analyzed there to see that it meets the prescribed requirements but the fuel oil, used in making the gas, as well as other supplies are chemically and physically tested. This is just one more evidence of the care exercised and of the manysided aspects of the manufacture of gas for domestic and industrial purposes.

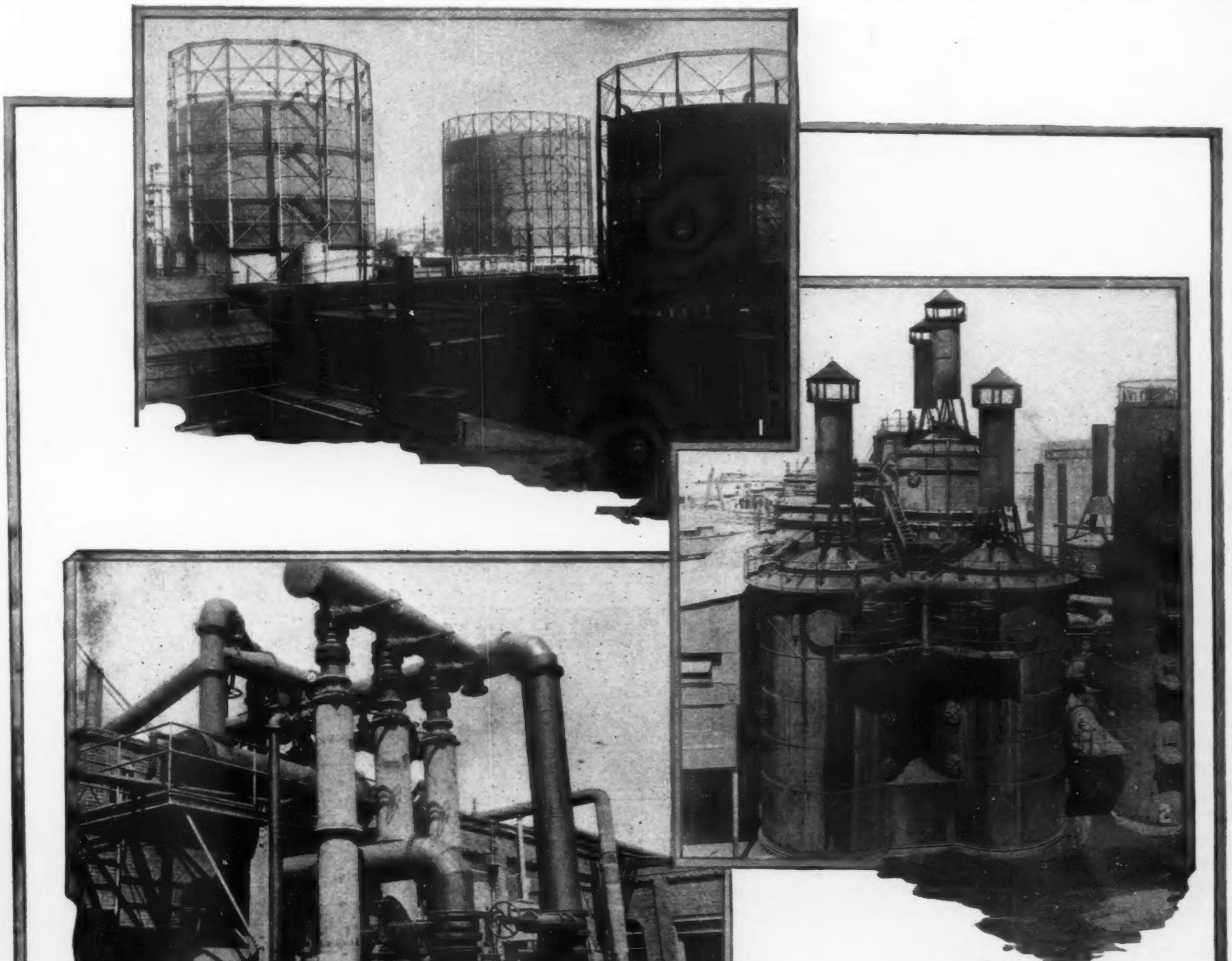
The City of Coronado lies across the bay from San Diego, where it occupies a long peninsula. Coronado is famous as a resort and as a place of attractive homes. Coronado gets its gas from the San Diego Consolidated Gas & Electric Company; and the gas is transmitted through two 4-inch high-pressure lines laid upon the water bed of the bay for a distance of 3,500 feet. The first line was laid in 1909, and the second line in 1921. The pipe sections are equipped with ball-and-socket joints calked with lead. This method of joining the pipe sections insured sufficient flexibility to permit of their assembly successively on a barge so that they could be slid on to the water bed down a guideway formed of two logs—the outer ends of the logs being weighted sufficiently to cause them to rest on the bottom of the bay. The upper ends, of course, were secured to the barge, where three lengths of piping were assembled at a time.

What has already been done in furnishing San Diego and outlying communities with an ample supply of gas is a fair index of what will occur in the same region in the way of future development. San Diego appeals by reason of the many things that Nature has provided within that favored territory. There is the long and picturesquely varied shore line, and then, inland, the "back country" with its own range of distinctive charms. And besides these, there are mountains and desert sections—all with differences in climate and attractions.

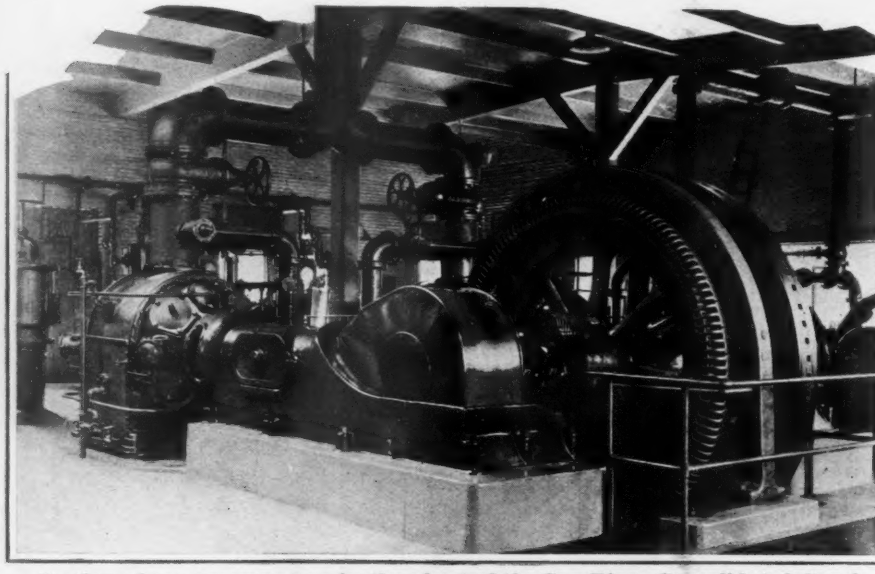
It is inevitable that other towns or residential communities will spring up in this part of California; and each of these. in turn, will look to San Diego for the gas which will mean so much to the comfort and to the convenience of the dwellers there. When this demand arises the capacity and the facilities of the San Diego Consolidated Gas & Electric Company will be found ample and ready to meet the expanding requirements.

The San Diego Consolidated Gas & Electric Company welcomes visitors to its plant: and a tour through the works is both interesting and informative. It is well worth the consumer's while to take advantage of this atti-

Top, left—Much frequented section of Balboa Park. Right—An ornamental date palm in a San Diego garden. Bottom, left—Tower of Jewels, Balboa Park. Right—Where gold fish and aquatic plants arrest the visitor in Balboa Park.



1—The three storage holders in this picture have a combined capacity of 8,500,000 cubic feet of gas. 2—These three oil-gas generators can produce 15,000,000 cubic feet of gas a day. 3—Aftercoolers which cool and dehydrate the gas while it is under pressure. 4—Another view of the oil-gas generators, scrubbers, etc. By-product carbon is dried for briquetting in the cylindrical kiln shown in the foreground. 5—Analyses of the gas are continually made in the laboratory to insure the fuel being up to standard in every particular.



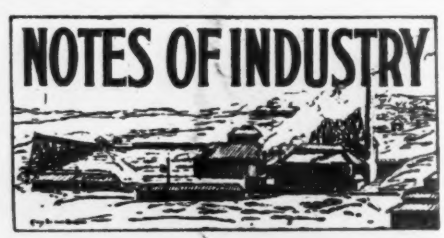
Section of compressor room in the plant of the San Diego Consolidated Gas & Electric Company, showing some of the Ingersoll-Rand machines that compress the gas for distribution.

tude on the company's part. because then he can see how many things must be done to provide him with gas and to make that gas of a uniform standard that will insure satisfaction at all times. Long as gas has been manufactured for domestic use, still the art is in a state of flux; and the public-service corporation must be continually on the watch to effect economies and to realize betterments for the good of all concerned. The San Diego Consolidated Gas & Electric Company is an excellent example of this spirit of enterprise and readiness to improve wherever practicable. The company has been in business since 1881.

PNEUMATIC DEVICE SHIFTS LOCOMOTIVES IN SHOP

AN air-operated locomotive shifting device is doing work in the shops of the Chicago, Burlington & Quincy Railroad Company that formerly called for the services of a switching engine. The device, which was conceived by J. B. Irwin, shop superintendent, is compact and is moved from place to place by an overhead crane. It is reported to be capable of exerting sufficient force to shift the heaviest locomotive and tender either forward or backward approximately 20 feet in 1½ minutes. In spotting a locomotive for one purpose or another, movements as little as 1/16 inch can be effected by it without difficulty. The use of this pneumatic shifter is said to save at least one shop day on each locomotive overhauled.

Mexico has definitely decided on the route of the road that is to form a part of the Pan American Highway. According to a memorandum from the National Highway Commission, the road will enter Mexico at Laredo, continuing south through Monterey, Ciudad Victoria, Valles—with a branch to Tampico, Pachuca, and Mexico City, and thence southeast to Puebla, Oaxaca, the Isthmus of Tehuantepec to the border of Guatemala. Certain stretches of this highway have been completed and others are well underway.



Draw bars that have become elongated in service and therefore permit too much play between a locomotive and its tender must be shortened, and this is accomplished by what is known as "bumping"—that is, heating the bar and repeatedly raising and dropping it endwise on an iron block until it is shortened to the desired extent. Instead of using man power to do this work, as is generally the case especially in small shops, the Atchison, Topeka & Santa Fe Railway now utilizes an air-operated bumping device of its own make.

More than 19,300,000 telephones it is estimated are now in use throughout the United States.

The humble peanut may be raised to the high estate of furnishing lustrous raiment for her ladyship, for it has been authoritatively stated that its shell is a potential source of rayon—silk of man's making.

Speaking of moving mountains, Seattle is shifting a small one standing in the heart of its business district into Puget Sound by way of a belt-conveying system. The main conveyor used for dumping has a length of 10,000 feet.

In 1928 the southern states used 152,767,338 pounds of industrial explosives, representing 30 per cent of the total amount consumed in the United States.

The Sudan is the source of about 80 per cent of the world's supply of gum arabic.

Statistics have it that the use of electric power is increasing more rapidly in our southern states than in other sections of the Union. The South's share of the country's developed water power has climbed from 9.7 per cent in 1910 to 24.3 per cent.

The Swiss Locomotive & Machine Works, at Winterthur, have developed a high-pressure steam locomotive that is a distinct advance in the art, reports one of our commercial attachées. It is of the single-stage expansion type, and was built after years of experiments which proved that great savings in the consumption of coal and water could be effected by increasing the working pressure from 15 to 60 atmospheres. The locomotive is designed for passenger service, and is said to be living up to the claims made for it by its manufacturers.

Certain collieries in northern France are no longer confining themselves entirely to the sale of the coal produced by them but are using it as well for the generation at pit head of electric energy for their own requirements and for distribution to neighboring industries. This permits them to consume not only any excess coal but also the unmarketable low-grade coal and dust. Since the war, six such power plants have been constructed. These are interconnected, and range in capacity from 20,000 to 60,000 kilowatts.

Platinum may give way to some extent in the laboratory to far lower priced tantalum if the report be true that a German concern has succeeded in turning out large blocks and sheets of tantalum for the manufacture of basins and other utensils required by the chemist.

The 1928 output of automobile tires in the United States necessitated the use of approximately 299,500,000 pounds of cotton fabrics.

The newly established mercury-mining industry in Nevada has yielded a substantial revenue during 1928 when 298,528 pounds of quicksilver, valued at $459,576, was produced. An increase in output of 35 per cent is promised this year when two new plants will be added to those now in operation.

In the spray-painting of signs for its rolling stock, the Vienna Tramways are using magnetized stencils that effectually remain in place while the painting is being done.

A deposit of high-grade tungsten ore is reported to have been discovered at India Path, six miles from Lunenburg, Nova Scotia.

The United States now leads the world in the mining of copper, with an output, in 1928, of 52 per cent of the total production.

Including farms, about two-thirds of all homes in the United States now use electricity, according to statistics compiled by the National Electric Light Association.

Compressed Air Magazine

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EDITORIALS

OUR OWN CANE TO PRODUCE MORE SUGAR

LOUISIANA'S cane-sugar industry is staging an astonishing comeback, and it won't be long before lands that could until very recently be bought for a song will be selling at a handsome premium. This is not because the lands have improved in any way but because specialists have produced canes that are generally proof against the borer and very much richer in their sugar content. Furthermore, the new canes grow faster and more luxuriantly, and, what is equally important, they flourish with much less labor in cultivating them.

Statistics show that Louisiana, during the two decades between 1894 and 1914, produced on an average of 250,000 tons of sugar annually; but it is confidently predicted that the cane fields this year will yield about 300,000 tons, and do this on an acreage that is a good deal smaller than was the case in the period just mentioned. Where the older stock did well in growing 15 tons of cane to the acre, the new stock can be counted upon to average close to 25 tons an acre and even 40 tons under favorable growing conditions! Each ton of the new canes will give 7.2 pounds more of sugar than the canes previously planted.

The outstanding feature of this amazing development—the thing that will make the widest popular appeal—is the fact that the new canes have been developed from twenty-one eyes planted on a Louisiana plantation seven years ago. Out of that stock and the subsequent progeny, the state is likely to reap an abundant golden harvest and to reëstablish an industry that was widely believed to be in its decadence.

SHEETING PLANES INDUCED ARTIFICIALLY

WHERE Nature has not formed sheeting planes in deposits of granite, quarrying is generally made just that much more difficult and expensive. This is understandable because the blocks must be broken loose from the ledge by drilling a line of foot holes and then driving wedges in them. In the present issue, we deal with a granite quarry in North Carolina that has found a way to successfully circumvent Nature and to create sheeting planes artificially to facilitate getting out the stone at a moderate outlay in time, effort, and money.

The granite deposit thus worked is the crown or top of a vast mass of solid granite that is of a grain that fortunately splits with equal facility in any direction. Quarrying operations there would be nearly prohibitive but for the way sheeting planes can be induced that will free or "lift" a volume of stone having a superficial expanse of several acres. The procedure is almost ludicrously simple.

A lift hole, from 3 to 4 inches in diameter, is drilled vertically to a depth of from 5 to 8 feet—depending upon the maximum thickness of stone desired. The hole is then enlarged at the bottom by exploding half a stick of dynamite. Next, a small charge of powder is fired in the pocket, and that serves to start a circular cleavage area. Successive charges widen this zone. With this done, a pipe is inserted in the drill hole and the space around tamped. After that a connection is made with the air line and pressure built up and maintained throughout the cleavage zone. Presently, the crack is widened and the splitting continues until the air reaches the sloping contours of the deposit and breaks its way free at the thin edge of the detached mass. Thereafter, the quarryman proceeds as though Nature had formed a convenient sheeting plane to help him get out his stone.

FASHIONS IN FIGHTING SHIPS

AGITATION and argument in behalf of the recent bill authorizing the construction of fifteen cruisers for the United States Navy emphasized that our fighting fleet would be more or less blindfolded without these powerful scouting units. Admitting that the contention was well grounded, the fact remains that similar arguments have been advanced regarding other types of fighting craft at different times during the development of the so-called New Navy.

At one time the automobile torpedo heralded the doom of the battleship—at least that is what the torpedo advocate proclaimed. Flotillas of torpedo boats were going to outmatch the much larger and more costly types of naval vessels. And then came the torpedo-boat destroyer, and the torpedo boat disappeared—the destroyer taking its place in an amplified battle line and doing scouting work for which its high speed and improved seaworthiness equipped it. Next came the scout cruiser—an order of craft designed to combat the destroyer and to do the work cut out for it under sea conditions that would have gravely handicapped the destroyer.

Today, we have the scouting aircraft as an adjunct to the battle fleet; and the speed of reconnoitering a given area is increased tremendously. The thing of most interest to the layman is that these different developments seldom displace existing units—they merely amplify the facilities at the disposal of the strategist and make it that much harder for an enemy to do the unexpected.

Recently, the daily press revealed that each of the new large airships now under construction for the Navy is to carry five combat airplanes. The purpose of these airplanes is really to defend the airships and to fight other aircraft that might menace the dirigibles. The uninitiated may reasonably wonder where this multiplicity of battle units is going to end; and his mind will liken the situation to that described by Swift in his well-known lines:

"So, naturalists observe a flea
Has smaller fleas that on him prey;
And these have smaller still to bite 'em,
And so proceed *ad infinitum.*"

LET THE SUNSHINE IN

NATURE'S balm for the weakened body is fresh air and sunshine in plenty. The air because of its stimulating oxygen and the sunshine because its light and therapeutic rays are capable of bringing about physical reactions essential to a state of health. Conversely, just as we pollute the air and just as we interpose a veil between the sun and ourselves we reduce the beneficent properties that Nature has given these things upon which life so largely depends.

Most of us have probably wondered why certain Alpine cures expose the patients, nearly nude, to the sun at high altitudes; and we probably questioned why the same helpful results could not be obtained at low altitudes. The answer is that the lower strata of the atmosphere, because of suspended matter of one sort or another, act like a filter to extract from the sunshine the ultra-violet rays that otherwise would reach the sea level. It is the ultra-violet rays that promote convalescence and bodily vigor at high altitudes. Just as the lower strata of the atmosphere are beclouded with smoke, the people living beneath that veil are denied the benefits of fresh air and unimpaired sunlight.

Such being the case, one can readily understand the steadily increasing agitation against belching chimneys and smokestacks—the dwellers in such an environment are being penalized to an extent realized by relatively few of them. The well-being of a community may be jeopardized in direct proportion as the air is befouled with smoke—much of it the result of careless stoking. This situation is bad enough at any time; but especially serious during the shorter days of the winter months—a period when respiratory diseases are usually most prevalent. It has been authoritatively stated that smoke in New York City may cause as much as a 40 per cent loss in the normal sunlight of the wintertime; and New York is not the worst example of offend-

ers of this sort among American cities.

Glass for the glazing of windows has been developed that will let through a much larger percentage of the sun's ultra-violet rays than ordinary window glass; and the day is probably not a distant one when glass of this nature will be pretty generally used. In short, the "ultra-violet home" has been forecast; but such a desirable habitation will be impossible unless equally active steps be taken to suppress smoke and keep the atmosphere clean.

CANADIAN LIGNITE PRODUCES SUPERIOR BRIQUETTES

SUCCESS in briquetting lignite upon a commercial scale has finally rewarded years of experimenting on the part of the Dominion Collieries, Ltd., at Bienfait, Saskatchewan. This climax is the outcome of coöperation on the parts of the Federal, Manitoba, and Saskatchewan governments, and represents work that has been carried on for fully eleven years.

The briquetting of lignite is not, in itself, essentially novel; but what has been done in this direction in the Dominion of Canada is different in that a low-grade fuel is transformed into a high-grade fuel, and that by-products of considerable economic value are obtained the while. As may be recalled, the plant at Bienfait was started under the auspices of the Lignite Utilization Board in 1918—directly due to war-time pressure; and the object was to find ways to make Canada less dependent upon foreign coal. Canada has vast deposits of lignite.

The investigations revealed that lignite, when carbonized, produced a form of coke which could be briquetted, and that 2 tons of lignite would yield 1 ton of briquettes closely approximating anthracite coal in its characteristics—the 1 ton of briquettes having substantially the same heating value as the 2 tons of lignite from which it was made. The by-products were oil, pitch, ammonia sulphate, etc. The significance of this accomplishment can be better understood when we bear in mind that lignite falls quickly to pieces when mined and that, in normal condition, it is extremely restricted in its utilization as a domestic or an industrial fuel.

With the way satisfactorily paved for commercial operation, the plant was taken over by the Saskatchewan Government, which then sought to interest private enterprise. Capital was obtained from Great Britain about a year ago; and $600,000 has been spent in developing and further equipping the plant at Bienfait, which is now turning out 100 tons of briquettes a day and is expected soon to be producing at the rate of 200 tons a day. Measured by production in the anthracite region of the United States, that daily output is comparatively trifling; but it does mean that the province will henceforth be the better able to provide satisfactory fuel for its own needs instead of importing three-quarters of the coal consumed by it.

There are other countries possessed of large and even enormous deposits of lignites—most of them used to a limited extent and confessedly at a very considerable loss in efficiency. What has been achieved at Bienfait will indicate in a general way what others may do with their lignites. Further operation at the Bienfait plant will, therefore, be watched with increased interest the world over. The problem there bristled with many difficulties. We have in the success so won another example of what may be gained through patient, painstaking research.

ANNUAL SURVEY OF AMERICAN CHEMISTRY, Volume III. Edited by Clarence J. West. A book of 395 pages, published by the Chemical Catalog Company, Inc., for National Research Council, Price, $3.00. New York City.

THE publication of the first volume of the Survey was somewhat of a venture, but time has generally confirmed the wisdom of the procedure and the value of a work that is designed to be essentially of a national character. The tendency now is to deal primarily with only the more outstanding topics of interest to American chemists, and, therefore, the book will be found of especial interest to them. The contributors are all men well known in their respective departments.

LAYOUTS FOR ADVERTISING, by John Dell. An illustrated work of 175 pages, published by Frederick J. Drake & Co., Chicago, Ill. Price, $3.00.

THIS is one of numerous self-educational books published by the company mentioned, and, like the rest of them, is admirably suited for this form of service or self-help. The purpose is to show the student how to arrange or design his advertising layout so as to catch and to hold the attention of the prospective purchaser—be the advertising medium a magazine, a newspaper, a booklet, etc., etc. The principals employed are those that have proved themselves effective over years of application.

THE BRIDGES OF PITTSBURGH, by Joseph White and M. W. von Bernewitz. A copiously illustrated book of 113 pages, published by Cramer Printing & Publishing Company, Pittsburgh, Pa. Price, $5.00.

SITUATED as it is where the Allegheny and the Monongahela rivers come together at their junction with the Ohio River, and because of other physical circumstances, it is easy to realize how bridges have come to play important parts in promoting intercommunication within the district concerned. One by one, these structures have been thrown across the two waterways; and each, in its turn, has met the need that pressed for recognition for a considerable while before it was answered. The first span was built in 1818; and today there are 43 bridges across the rivers. The book describes the different structures and their respective purposes; and the volume contains much valuable data.

THE RADIO MANUAL, by George E. Sterling, member Institute of Radio Engineers. An illustrated volume of 666 pages, published by the D. Van Nostrand Company, Inc., New York City. Price, $6.00.

THE work has been prepared to serve as a guide and a textbook to those that expect to enter the radio profession as engineers or inspectors or to become either commercial or amateur operators. The comprehensiveness of the volume is a fair indication of the many-sided nature of modern radio means of communication and of the knowledge that must be had to make the most of the equipment today available. The book bears further evidence to the state of flux in which the whole art now is. The work should be well worth while to many people.

THE EIGHTH WONDER. An illustrated book, issued by B. F. Sturtevant Company, Hyde Park, Boston, Mass.

THIS volume deals with the Holland Tunnel under the North River, and, incidentally, reveals the part played by the ventilating system in making the twin tubes the great successes they are as subaqueous vehicular highways linking New York City with neighboring Jersey City. Basically, the ventilating system depends upon a number of large electrically driven blower plants; and the B. F. Sturtevant Company, which furnished the blowers, very rightly is proud of the manner in which they are performing the indispensable work expected of them.

High Explosives and Blasting Powders and *Blasting Supplies* are the titles of two booklets, recently issued by the Hercules Powder Company of Wilmington, Del., which can be obtained gratis upon application by any responsible person.

Rocks and Minerals is the title of a magazine published quarterly by Peter Zodac, Peekskill, N. Y. The subscription price is $1 a year in the United States; and the magazine frequently contains articles of outstanding interest.

The Thermal Expansion of Fireclay Bricks, price 20 cents, and *An Investigation of Checkerbrick For Carbureters of Water-Gas Machines*, price 50 cents, are the titles of bulletins issued by the University of Illinois, Urbana, Ill.

Commercial Forms is the title of a pamphlet issued by the Department of Commerce in its efforts to eliminate waste through simplified practice.

Houghto-Clean is the title of a booklet recently issued by E. F. Houghton & Company, Philadelphia, Pa. The booklet describes the general problem of industrial cleaning and how the work can be done with the preparations manufactured by the company concerned.

Breaking with Tradition is the title of a pamphlet descriptive of I-R surface condensers and issued by the Ingersoll-Rand Company of New York City.

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